POLARAD

HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS

MICROWAVE SIGNAL GENERATOR MODEL MSG-34

Electronic Services - Los Angeles
M14713X

POLARAD ELECTRONIC INSTRUMENTS,
DIVISION OF POLARAD ELECTRONICS CORPORATION
34-02 QUEENS BLVD., LONG ISLAND CITY 1, N. Y.

POLARAD

INSTRUCTION MANUAL

MICROWAVE
SIGNAL GENERATOR
MODEL MSG-34

This handbook covers equipment prefixed by the following serial numbers:

Group 1 Units (see Addendum) --- 8-1 and up;

Group 2 Units (see Addendum) --- 141, 171, 184, 193, 227, 231, 240, 247, 278, 281 through 284, 292 through 302, 306, 308, 311, 312, 315, 318, 320, 323, 324, 326, 330, 335 through 345, and 347 through 369.

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A DIVISION OF POLARAD ELECTRONICS CORPORATION
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TABLE OF CONTENTS

Paragraph		Page
	SECTION I—INTRODUCTION	
1-1	Scope of Manual	1-1
1-3	Purpose and Use of the Equipment	1-1
1-5	General Description	1-1
1-9	Equipment Supplied	1-1
1-11	Technical Characteristics	1-2
1-13	Electron Tube, Crystal Diode, Fuse, and Indicator Lamp Complement	1-3
	SECTION II—OPERATION	
2-1	General	2-1
2-3	Equipment Installation	2-1
2-5	Operation	2-1
2-7	Operating Controls, Indicators, and Connectors	2-2
2-8	Starting Procedure	2-2
2-9	Operating Procedures	2-6
2-10	Setting Frequency and Calibrating Output Power	2-7
2-11	CW (Continuous-Wave) Operation	2-7
2-12	Internally Synchronized Square-Wave-Modulated Operation	2-7
2-13	Internally Synchronized Pulse-Modulated Operation	2-8
2-14	Externally Synchronized Pulse-Modulated Operation	2-8
2-15	External Pulse-Modulated Operation	2-9
2-16	Internally Synchronized FM Operation	2-9
2-17	External Frequency-Modulation Operation	2-10
2-18	Stopping Procedures	2-10
2-19	Packaging Instructions	2-10
2-20	Packaging for Short-Term Storage	2-10
2-21	Packaging for Long-Term Storage or Shipment	2-10
	SECTION III—THEORY OF OPERATION	
3-1	General	3-1
3-3	Simplified Block Diagram Analysis	3-1
3-5	Detailed Block Diagram Analysis	3-1
3-6	Zero Set Operation	3-1
3-7	CW Operation	3-1
3-8	FM Operation	3-1
3-9	Internal Pulse Operation	3-1
3-10	Internal Square-Wave Operation	3-1
3-11	External Modulation	3-1
3-12	External Frequency Modulation	3-2
3-13	Internal Synchronization	3-2
3-16	External Synchronization	3-2
3-18	Detailed Circuit Analysis, Modulator Section	3-2
3-20	Rate Generator V201, V202, and V203	3-2
3-26	Puller Amplifier V209A	3-7
3-27	Undelayed Sync Blocking Oscillator V209B	3-7
3-29	Delay Phantastron V205 and Cathode Follower V204A	3-8
3-32	Buffer Amplifier V204B	3-8
3-33	Blocking Oscillator V206A	3-8

TABLE OF CONTENTS (Cont'd)

Paragraph		Page
	SECTION III—THEORY OF OPERATION (Cont'd)	
3-34	Delayed Sync Blocking Oscillator V206B	3-8
3-35	Width Multivibrator V211	3-8
3-37	Cathode Follower V210	3-8
3-38	Phase Inverter V207A	3-9
3-40	Clipper Amplifier V207B	3-9
3-41	Schmitt Trigger V208	3-9
3-42	Phase Inverter V212	3-9
3-43	Detailed Circuit Analysis, Keyer Circuits	3-9
3-45	Video Amplifier V107 and Keyer Amplifier V108	3-9
3-47	Detailed Circuit Analysis, Oscillator Section	3-9
3-49	Reflex Klystron R-F Oscillator V102	3-9
3-51	Klystron Cavity	3-10
3-52	Mode Switching	3-10
3-53	Repeller Voltage Tracking Circuit	3-10
3-54	Protective Diode V101	3-11
3-56	Functional Operation of the Mechanical Components	3-11
3-57	Power Monitoring Circuit	3-12
3-60	Detailed Circuit Analysis, Power Supplies	3-13
3-62	Beam Power Supply	3-13
3-64	Repeller Power Supply	3-13
3-65	Keyer Power Supply	3-14
3-66	Modulator Power Supply	3-14
	SECTION IV—MAINTENANCE	
4-1	General	4-1
4-3	Test Equipment Required	4-1
4-5	Preliminary Inspection	4-1
4-7	Removal of Model MSG-34 from Dust Cover	4-1
4-8	Removal of R-F Head from Basic Unit	4-1
4-10	Minimum Performance Standards	4-1
4-12	System Troubleshooting	4-1
4-14	Troubleshooting Power Supplies	4-1
4-16	Troubleshooting Modulator Unit and RF Tuning Head	4-5
4-17	Disassembly and Reassembly Instructions	4-5
4-19	Removal of Thermistor Probe Assembly	4-5
4-20	Replacement of Thermistor Probe Assembly	4-18
4-21	Removal of Thermistor Compensator Assembly	4-18
4-22	Replacement of Thermistor Compensator Assembly	4-28
4-23	Removal of Attenuator Probe Assembly	4-28
4-24	Replacement of Attenuator Probe Assembly	4-28
4-25	Replacement of Reflex Klystron Oscillator Tube	4-30
4-26	Adjustment and Calibration Procedures	4-30
4-28	Adjusting Output Level of +210 Volt Supply	4-30
4-29	Setting Low Frequency Adj Control R217	4-31
4-30	Setting Square-Wave Symmetry Adj Control R211	4-31
4-31	Setting Minimum Delay Adj Control R233	4-31
4-32	Setting Maximum Delay Adj Control R276	4-31
4-33	Setting Minimum Width Adj Control R315	4-33
4-34	Setting Bias Adj Control R309	4-33
4-35	Setting Bias Adj Control R238	4-33
4-36	Adjusting Output Level of Beam Supply	4-33
4-37	Adjusting Output Level of Repeller Supply	4-34
4-38	Repeller Voltage Tracking	4-34

TABLE OF CONTENTS (Cont'd)

Paragraph		Page
	SECTION IV—MAINTENANCE (Cont'd)	
4-39	Power Output Calibration	4-37
4-40	Setting Bias Adj Control R131	4-38
	SECTION V—DIAGRAMS AND TABLES	
5-1	General	5-1/5-2
	SECTION VI -- PARTS LIST	
6-1	Introduction	6-1
6-3	Ordering Information	6-1
6-4	How to Use the Parts List	6-1
	Addendum	A1/A2

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Model MSG-34 Microwave Signal Generator	vi
2-1	Model MSG-34 Microwave Signal Generator, Installation Outline Drawing	2-1
2-2	Model MSG-34 Microwave Signal Generator (Flush-Panel Rack-Mounted Configuration), Installation Outline Drawing	2-2
2-3	Model MSG-34 Front Panel Operating Controls, Indicators, and Connectors	2-3
2-4	Maximum Pulse Delay Versus Repetition Rate	2-6
2-5	Packaging Diagram	2-11/2-12
3-1	Model MSG-34 Microwave Signal Generator, Simplified Block Diagram	3-3/3-4
3-2	Model MSG-34 Microwave Signal Generator, Detailed Block Diagram	3-5/3-6
3-3	Waveforms, Undelayed Sync Blocking Oscillator V209B	3-7
3-4	Typical Repeller Voltage Versus Frequency Characteristic Curve	3-11
3-5	R-F Oscillator Simplified Electro-mechanical Diagram	3-12
3-6	Power Supplies, Functional Block Diagram	3-13
4-1	Test Setup to Determine Power Set Operation	4-5
4-2	Test Setup to Determine CW Operation	4-13
4-3	Test Setup to Determine INT SQ WV Operation	4-13
4-4	Test Setup to Determine INT PULSE Operation	4-13
4-5	Test Setup to Determine Characteristics of Undelayed Sync Output Pulses	4-14
4-6	Test Setup to Determine Characteristics of Delayed Sync Output Pulses	4-14
4-7	Test Setup to Determine Externally Synchronized Pulse Modulated Operation	4-14
4-8	Test Setup to Determine FM Operation	4-15
4-9	Typical Oscilloscope Display of Internally Synchronized Frequency-Modulated Output	4-15
4-10	Test Setup to Determine EXT MOD Operation	4-16
4-11	Test Setup to Determine Output VSWR	4-16
4-12	Test Setup to Determine External Frequency-Modulation Output	4-16
4-13	Test Setup to Determine Sawtooth Modulating Signal Output	4-17
4-14	Modulator Power Supply, Top View	4-17
4-15	Repeller and Beam Chassis, Top View	4-18
4-16	Modulator Assembly, Component Layout	4-19
4-17	RF Tuning Head	4-20
4-18	Thermistor Probe and Thermistor Compensator Assemblies, Exploded View	4-28
4-19	Attenuator Probe Assembly, Exploded View	4-29
4-20	Reflex Klystron Oscillator, Exploded View	4-32
4-21	Tracking Repeller Voltage, Equipment Setup	4-35
4-22	Typical Adjustable Periphery Tuning Cam	4-35
4-23	Typical Mode Pattern Display	4-36
5-1	Modulator Assembly, Schematic Diagram	5-3/5-4
5-2	Model MSG-34, Microwave Signal Generator, Overall Schematic Diagram, Less Modulator Assembly	5-5/5-6

LIST OF TABLES

Table		Page
1-1	Equipment Supplied	1-1
1-2	Wrench Kit Tools	1-1
1-3	Electron Tube and Crystal Diode Complement	1-3
1-4	Fuse and Indicator Lamp Complement	1-5/1-6
2-1	Operating Controls, Indicators, and Connectors	2-4
4-1	Test Equipment Required	4-2
4-2	Preliminary Inspection Procedures	4-3
4-3	Minimum Performance Standards	4-6
4-4	Troubleshooting Procedures	4-21
5-1	Voltage and Resistance Measurements, MSG-34 Power Supplies	5-7
5-2	R-F and Keyer, Voltage and Resistance Measurements	5-10
5-3	Modulator, Voltage and Resistance Measurements	5-11
6-1	Manufacturer's Code	6-3
6-2	Parts List	6-9

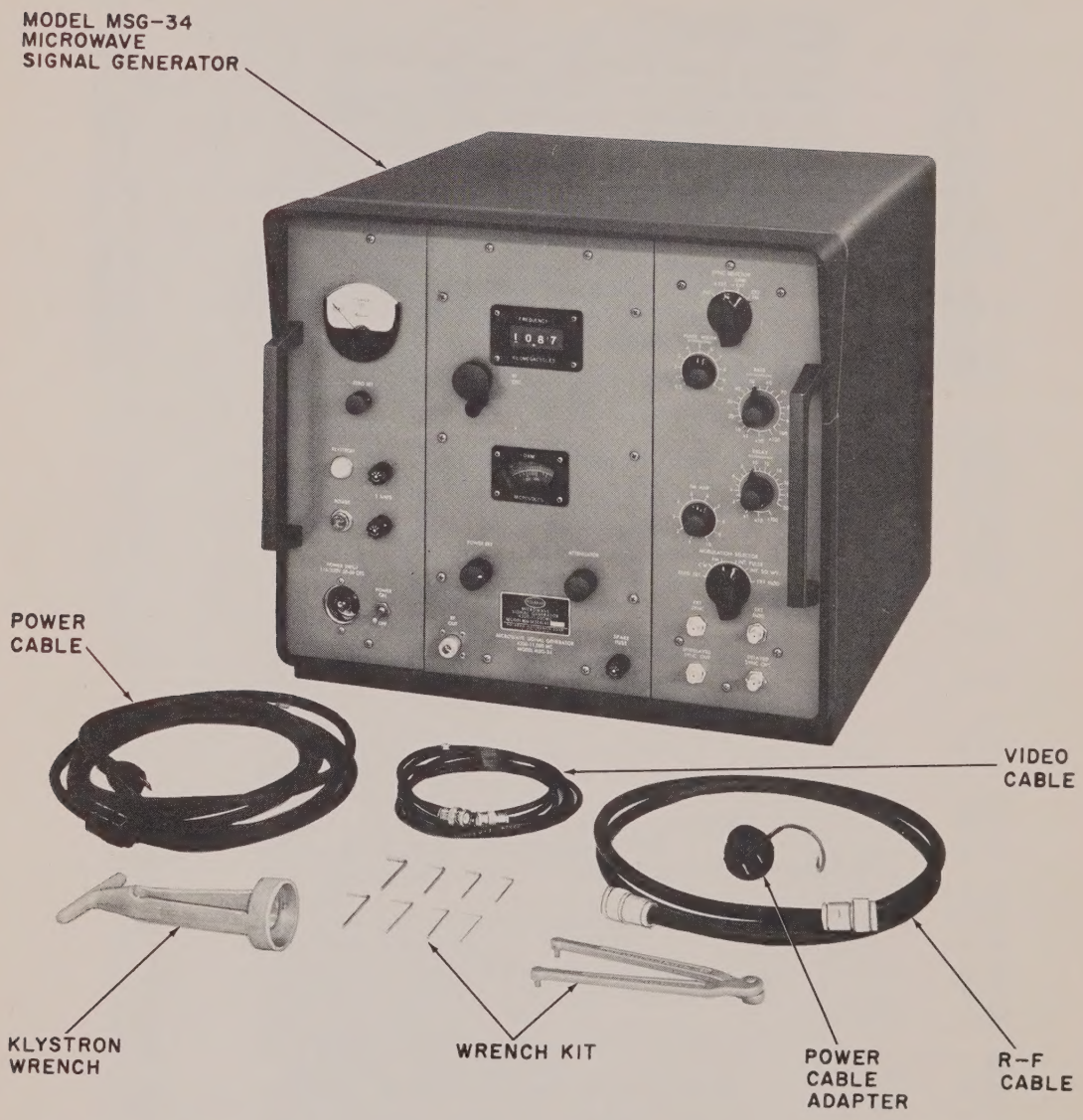


Figure 1-1. Model MSG-34 Microwave Signal Generator

SECTION I
INTRODUCTION

1–1. SCOPE OF MANUAL.

1-2. This manual contains instructions for the use, operation, and maintenance of the Model MSG-34 Microwave Signal Generator (see figure 1-1), manufactured by the Polarad Electronic Instrument Division of Polarad Electronics Corporation, Long Island City, New York. The manual includes a general description of the equipment, operating instructions, theory of operation, maintenance information, and schematic diagrams.

1–3. PURPOSE AND USE OF THE EQUIPMENT.

1-4. The Model MSG-34 Microwave Signal Generator is a precision instrument capable of generating low-power continuous-wave (cw), pulse modulated, square-wave modulated, or frequency modulated r-f signals within the range from 4,200 to 11,000 mc. The Model MSG-34 can be used in the testing of either narrow- or broad-band microwave systems and components such as antennas, attenuators, beacons, crystal mounts, hybrid junctions, preselectors, radar sets, receivers, and traveling-wave-tube amplifiers. Specific measurements that can be made include attenuation, bandwidth, calibration accuracy, power gain, sensitivity, and VSWR.

1–5. GENERAL DESCRIPTION.

1-6. The Model MSG-34 Microwave Signal Generator is a self-contained, compact, and portable unit consisting of a basic unit and a plug-in r-f head. In operation, the plug-in r-f head is mounted in the basic unit so that the two combine to appear as a single assembly (see figure 1-1).

1-7. The basic unit contains the control, modulating, and monitoring circuitry of the MSG-34 system, and consists of a panel, chassis, and frame assembly. The front panel assembly occupies either side of the equipment frame and serves as a mounting for the basic unit operating controls, indicators, and connectors. The center section of the basic unit frame has a panel opening that is designed to accept the plug-in r-f head.

1-8. The plug-in r-f head contains the r-f signal generating and keying circuitry of the MSG-34 system. This single r-f head is continuously tunable throughout the entire frequency range of the equipment, and consists of a front panel, chassis, and frame assembly. The front panel assembly serves as a mounting for the r-f head operating controls, indicators, and connector.

1–9. EQUIPMENT SUPPLIED.

1-10. The components that constitute the complete Model MSG-34 Microwave Signal Generator System are listed in table 1-1. (See figure 1-1.)

TABLE 1-1. EQUIPMENT SUPPLIED

Component	Polarad Model or Part Number
Microwave Signal Generator	MSG-34
R-f Cable	BP12551
Video Cable	BP12553
Power Cable	B111144
Power Cable Adapter	A131966
Wrench Kit*	A25109
Klystron Wrench	A124347

*See table 1-2.

TABLE 1-2. WRENCH KIT TOOLS

Tool	Polarad Part No.
Spanner Wrench	A15550
#4 Spline Wrench	A515101
#6 Spline Wrench	A515102
#8 Spline Wrench	A515103
#10 Spline Wrench	A515104
#4 Allen Wrench	A515301
#6 Allen Wrench	A515302
#8 Allen Wrench	A515303
#10 Allen Wrench	A515304

1—11. TECHNICAL CHARACTERISTICS.

1-12. The technical characteristics of the Model MSG-34 Microwave Signal Generator are listed as follows:

Frequency range	4,200 to 11,000 mc in one band
Frequency dial accuracy	± 1%
Maximum calibrated output power	1 milliwatt (o dbm)
Output power range	0 to -127 dbm
Output attenuator accuracy	± 2.0db
Output impedance	50 ohms (nominal)
Output VSWR	2:1
Modulation	Internal square wave, internal or external FM, internal or external pulses
Output connector	Type N
Internal pulse modulation:	
Width	0.2 to 10 microseconds
Repetition rate	10 to 10,000 pps
Delay	2 to 2,000 microseconds
Rise time	0.1 microsecond
Decay time	0.1 microsecond
Sync	Internal, positive or negative pulse or sine wave
External pulse modulation:	
Polarity	Positive or negative
Repetition rate	10 to 10,000 pps
Width	0.2 to 100 microseconds
Amplitude	10 to 40 volts peak
Internal square-wave modulation:	
Rate	10 to 10,000 cps
Symmetry	± 10%
Sync	Internal
Internal Frequency modulation:	
Type	Linear sawtooth
Maximum frequency excursion	± 2.5 minimum
Rate	10 to 10,000 cps
External frequency modulation:	
Frequency	10 cps to 100 kc
Maximum frequency excursion	5 mc (minimum)
Output sync pulses:	
Type	Positive pulse, delayed or undelayed
Rate	10 to 10,000 pps
Amplitude	15 volts peak minimum
Rise time	Less than 0.1 microsecond
External sync:	
Type of input	Positive, negative pulse or sine wave
Amplitude	Pulse 5 to 50 volts peak Sine wave 5 to 40 volts rms
Power requirements:	115 or 230 volts rms, 50 to 60 cps, single phase, 300 watts

1—13. ELECTRON TUBE, CRYSTAL DIODE, FUSE, AND INDICATOR LAMP COMPLEMENT.

1-14. Table 1-3 lists the types and functions of the complement of electron tubes and semiconductor diodes employed in the equipment. The types and functions of the fuses and indicator lamps used in the equipment are listed in table 1-4.

TABLE 1-3. ELECTRON TUBE AND CRYSTAL DIODE COMPLEMENT

Reference Symbol Number	Electron Tube or Semiconductor Diode Type	Function
Modulator Assembly		
CR203	1N625	Clipper
CR204	1N198	Plate catching diode
CR205	1N198	Damper
CR206	1N198	Clamping diode
CR211	1N198	Clipper
CR212	1N198	Clipper
CR213	1N198	Clamping diode
V201	5725	Phantastron rate generator
V202	12AT7	A- Coupling amplifier B- Coupling amplifier
V203	5725	Phantastron rate generator
V204	12AT7	A- Cathode follower B- Buffer amplifier
V205	5725	Delay phantastron
V206	5687	A- Blocking oscillator B-Delayed sync blocking oscillator
V207	12AT7	A- Phase inverter B- Clipper amplifier
V208	12AU7	Schmitt Trigger
V209	5687	A- Puller amplifier B- Undelayed sync blocking oscillator
V210	12AU7	Cathode follower
V211	6AN8	Width multivibrator
V212	6AH6	Phase inverter

(Cont'd)

TABLE 1-3. ELECTRON TUBE AND CRYSTAL DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Electron Tube or Semiconductor Diode Type	Function
Modulator Power Supply Assembly		
V13	5Y3	Rectifier
V14	6AR6	Series regulator
V15	12AX7	Amplifier
V16	OB2	Voltage regulator
V17	5Y3	Rectifier
V18	6080	Series regulator
V19	12AX7	D-c amplifier
V20	OA2	Voltage regulator
Beam and Repeller Power Supply Assembly		
CR1	4JA211AB1AA1	Full wave rectifier bridge
V1	5R4GY	Rectifier
V2	5R4GY	Rectifier
V3	5933	Series regulator
V4	12AX7	D-c amplifier
V5	5651	Voltage regulator
V6	5651	Voltage regulator
V7	5R4GY	Rectifier
V8	6AR6	Series regulator
V9	12AT7	D-c amplifier
V10	5651	Voltage regulator
V11	OA2	Voltage regulator
V12	OA2	Voltage regulator

TABLE 1-3. ELECTRON TUBE AND CRYSTAL DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Electron Tube or Semiconductor Diode Type	Function
R-F Head/Keyer Assembly		
CR103	1N198	Clamping diode
V101	6X4W	Protective diode
V102	ZV1011/8052	Klystron oscillator
V103	6X4	Rectifier
V104	6AR6	Series regulator
V105	12AX7	D-c amplifier
V106	not used	————
V107	6AH6	Amplifier
V108	6CL6	Amplifier

TABLE 1-4. FUSE AND INDICATOR LAMP COMPLEMENT

Reference Symbol Number	Type	Function
FUSES		
F1, F2 *	5 amp (SLO-BLO)	Power line protective fuses (located in basic unit)
F3 *	5 amp (SLO-BLO)	Spare
INDICATOR LAMPS		
DS1	NE51	KLYSTRON indicator lamp (located in basic unit)
DS2	NE51	POWER indicator lamp (located in basic unit)

* For 230-volt operation, replace with type 3AG rated at 2.5 amp, 250 volts.

SECTION II
OPERATION

2—1. GENERAL.

2-2. The Model MSG-34 is shipped complete and is ready to use upon delivery; no special or permanent installation procedures are necessary. The equipment can be used in either field or laboratory applications. It should be unpacked upon receipt, observing the usual precautions for unpacking a delicate instrument.

WARNING

THE MODEL MSG-34 WITH THE RF HEAD INSTALLED WEIGHS APPROXIMATELY 110 POUNDS. IT IS STRONGLY RECOMMENDED THAT TWO PERSONS BE EMPLOYED WHEN UNPACKING, LIFTING, TRANSPORTING, OR REPACKING THE EQUIPMENT.

2—3. EQUIPMENT INSTALLATION.

2-4. After unpacking the equipment, plan its installation. The Model MSG-34 is supplied mounted in a cabinet for either bench or cart use. The unit is also available in a flush-panel configuration for rack mounting.

a. Figure 2-1 illustrates the cabinet-mounted Model MSG-34.

b. Figure 2-2 illustrates the flush-panel rack-mounted Model MSG-34.

2—5. OPERATION.

2-6. The procedures for proper operation of the Model MSG-34 are described in paragraphs 2-8 through 2-18.

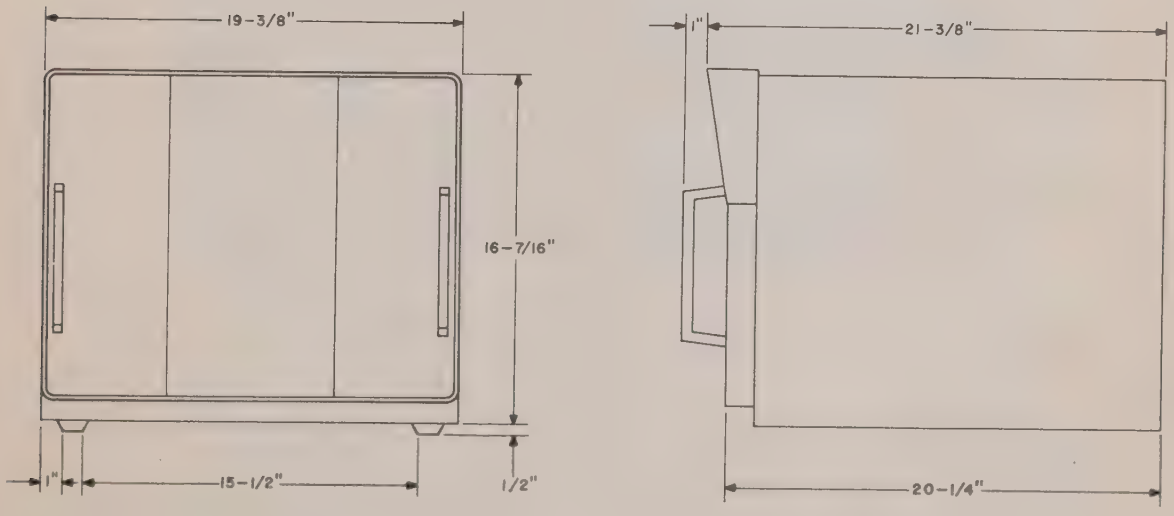


Figure 2-1. Model MSG-34 Microwave Signal Generator, Installation Outline Drawing

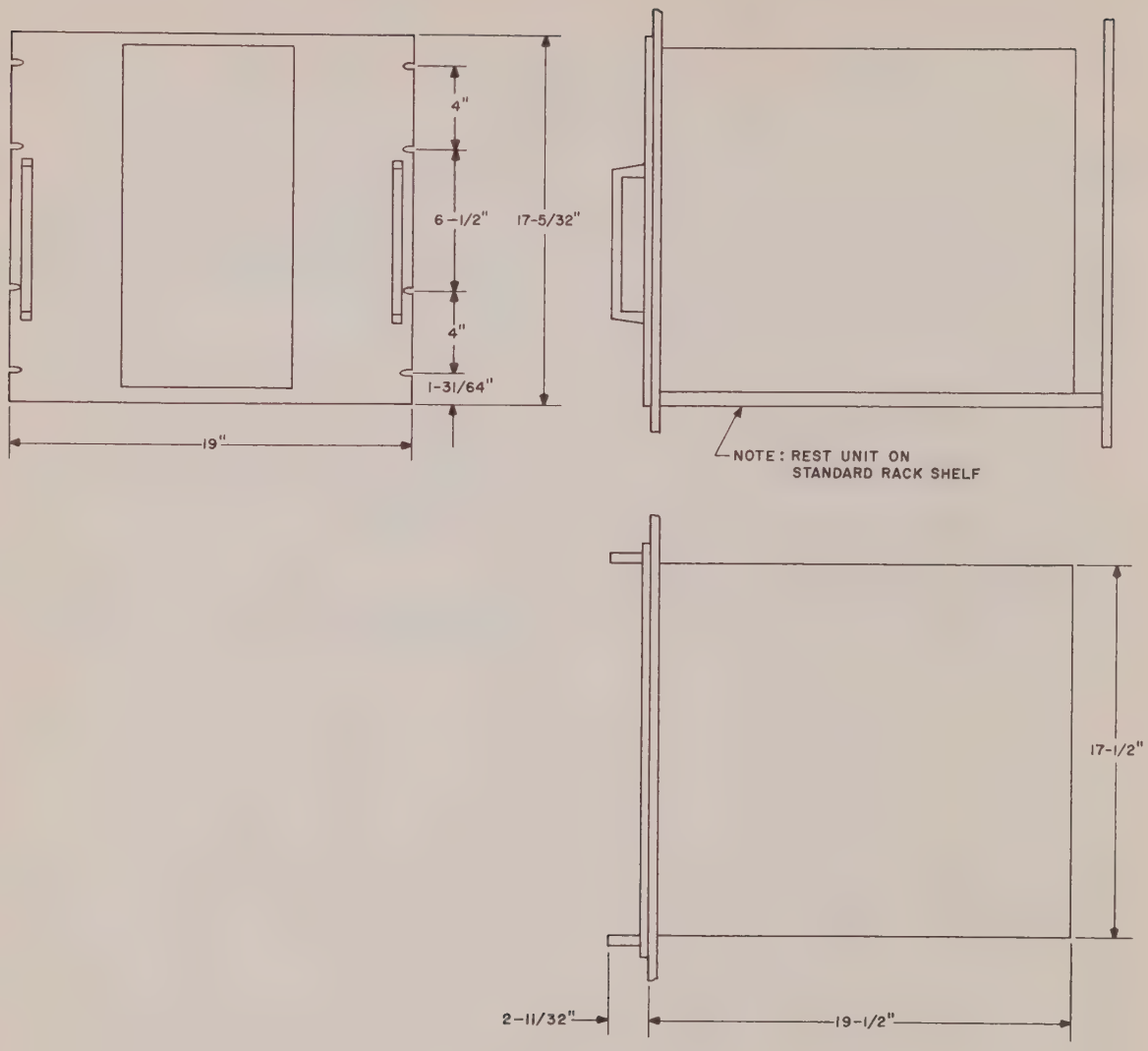


Figure 2-2. Model MSG-34 Microwave Signal Generator (Flush-Panel Rack-Mounted Configuration), Installation Outline Drawing

2-7. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators, and connectors necessary for the operation of the Model MSG-34 are located on the basic unit and tuning unit front panel assemblies, as shown in Figure 2-3. Their functions are described in Table 2-1.

2-8. STARTING PROCEDURE. The starting procedure for the Model MSG-34 is described in the following steps:

CAUTION

THE MODEL MSG-34 IS FACTORY SET FOR OPERATION ON A 115-VOLT, 50-60 CPS A-C POWER LINE. SHOULD OPERATION ON A 230-VOLT, 50-60 CPS A-C POWER LINE BE DESIRED, REMOVE THE DUST COVER AND SET THE 115/230 V SWITCH S2 to 230V. SWITCH S2 IS LOCATED ON A BRACKET ON THE LEFT SIDE OF THE BASIC UNIT. FAILURE TO DO THIS WILL RESULT IN THE EQUIPMENT DRAWING EXCESSIVE CURRENT, THEREBY CAUSING THE POWER LINE PROTECTIVE FUSES TO BLOW.

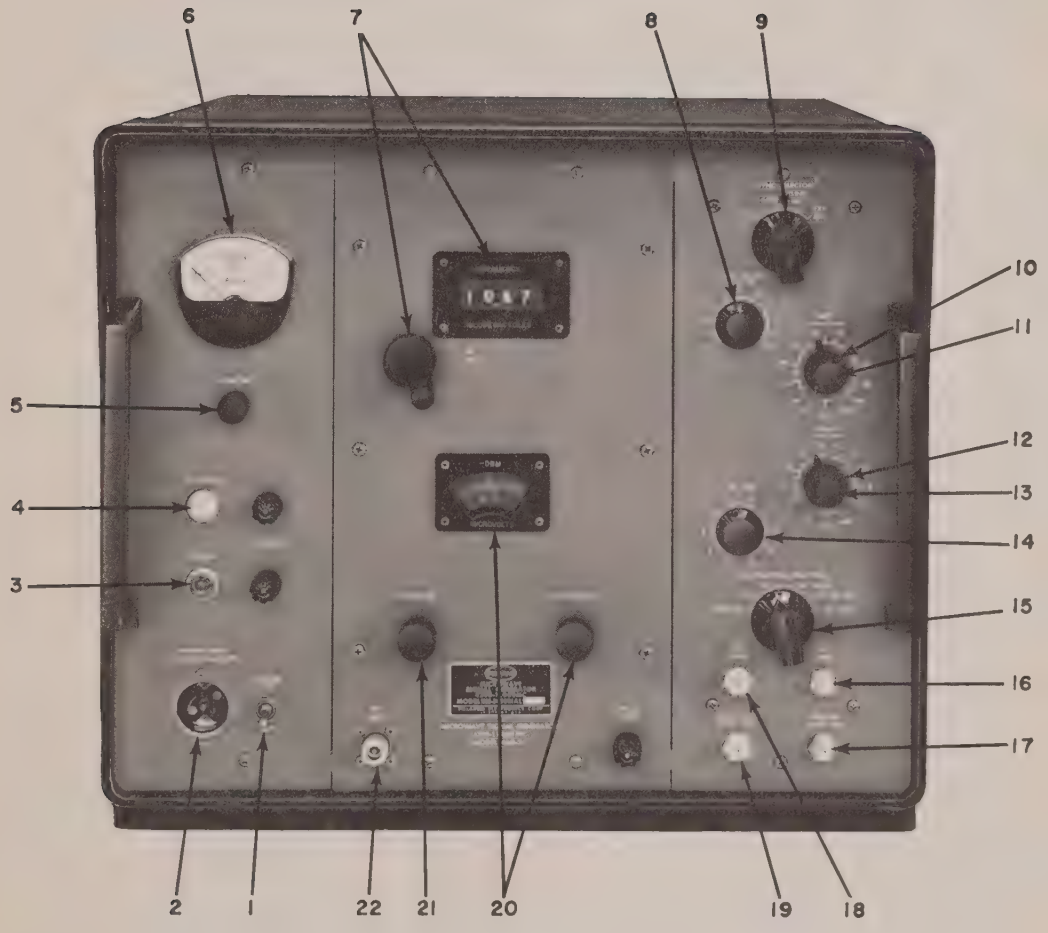


Figure 2-3. MSG-34 Front Panel Operating Controls, Indicators, and Connectors

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Front Panel Designation	Figure 2-3 Index No.	Function
POWER-ON-OFF switch	1	Energizes MSG-34
POWER INPUT 115V 50-60 CPS receptacle	2	Couples operating power to MSG-34.
POWER indicator	3	Illuminates when POWER-ON-OFF switch is set to POWER ON.
KLYSTRON indicator	4	Illuminates 60 seconds after POWER-ON-OFF switch is set to POWER ON.
ZERO SET control	5	Balances internal thermistor bridge so that power monitor meter indicates ZERO.
POWER SET meter	6	Provides a visual indication when zero-setting and power-setting MSG-34.
R-F OSC control and FREQUENCY KILOMEGACYCLES dial	7	Tunes MSG-34 to frequency indicated on dial.
PULSE WIDTH MICROSECONDS control	8	Adjusts width of r-f output pulse from 0.2 to 10 microseconds when MODULATION SELECTOR switch is set to INT PULSE position.
SYNC SELECTOR switch	9	Enables modulated r-f output signal to be either internally or externally controlled, as follows: a. When in INT position, repetition rate of modulation is internally controlled by RATE CYCLES/SECOND control and RATE CYCLES/SECOND multiplier switch when MODULATION SELECTOR switch is in FM, INT PULSE, or INT SQ WV position. b. When in +EXT or SINE-EXT position, repetition rate of modulation is determined by application of positive or negative pulse or sine wave. c. When in EXT FM position repetition rate of modulation is determined by externally applied frequency-modulation signal.
RATE CYCLES/SECOND control and RATE CYCLES/SECOND multiplier switch	10 and 11	Adjusts modulation repetition rate when SYNC SELECTOR switch is set to INT position.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (Cont'd)

Front Panel Designation	Figure 2-3 Index No.	Function
DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch	12 and 13	Adjusts delay between both r-f output pulse and delayed sync output pulse from 2 to 2000 microseconds (but not greater than 75% of pulse period, as shown in figure 2-4) after undelayed sync output pulse.
FM AMP control	14	Adjusts deviation about center frequency of r-f output pulse when MODULATION SELECTOR switch is set to FM position.
MODULATION SELECTOR switch	15	Selects type of modulated r-f output and permits MSG-34 to be zero-set.
EXT MOD connector	16	Enables MSG-34 to be externally pulse modulated when MODULATION SELECTOR switch is set to that position which corresponds to the external modulating signal.
DELAYED SYNC OUT connector	17	Provides positive video trigger pulse in time coincidence with leading edge of r-f output pulse when MODULATION SELECTOR switch is set to FM, INT PULSE, or INT SQ WV position, and is independent of SYNC SELECTOR switch setting.
EXT SYNC connector	18	Enables MSG-34 to be externally synchronized with a pulse or sine-wave signal when the MODULATION SELECTOR switch is set to INT PULSE and the SYNC SELECTOR switch is set to that position that corresponds to the external sync signal.
UNDELAYED SYNC OUT connector	19	Provides positive video trigger pulse which leads both r-f output pulse and delayed sync output pulse in time when MODULATION SELECTOR switch is set to FM, INT PULSE, or INT SQ WV position, and is independent of SYNC SELECTOR switch setting.
ATTENUATOR control and -DBM MICROVOLTS dial	20	Adjusts output level of MSG-34 to any value between O dbm and -127 dbm (0.223 volt rms to 0.1 millivolt) as indicated on dial.
POWER SET control	21	Provides reference power level of one milliwatt (O dbm), as indicated by power monitor meter indication of POWER SET.
RF OUT connector	22	Couples r-f output of MSG-34 to equipment under test.

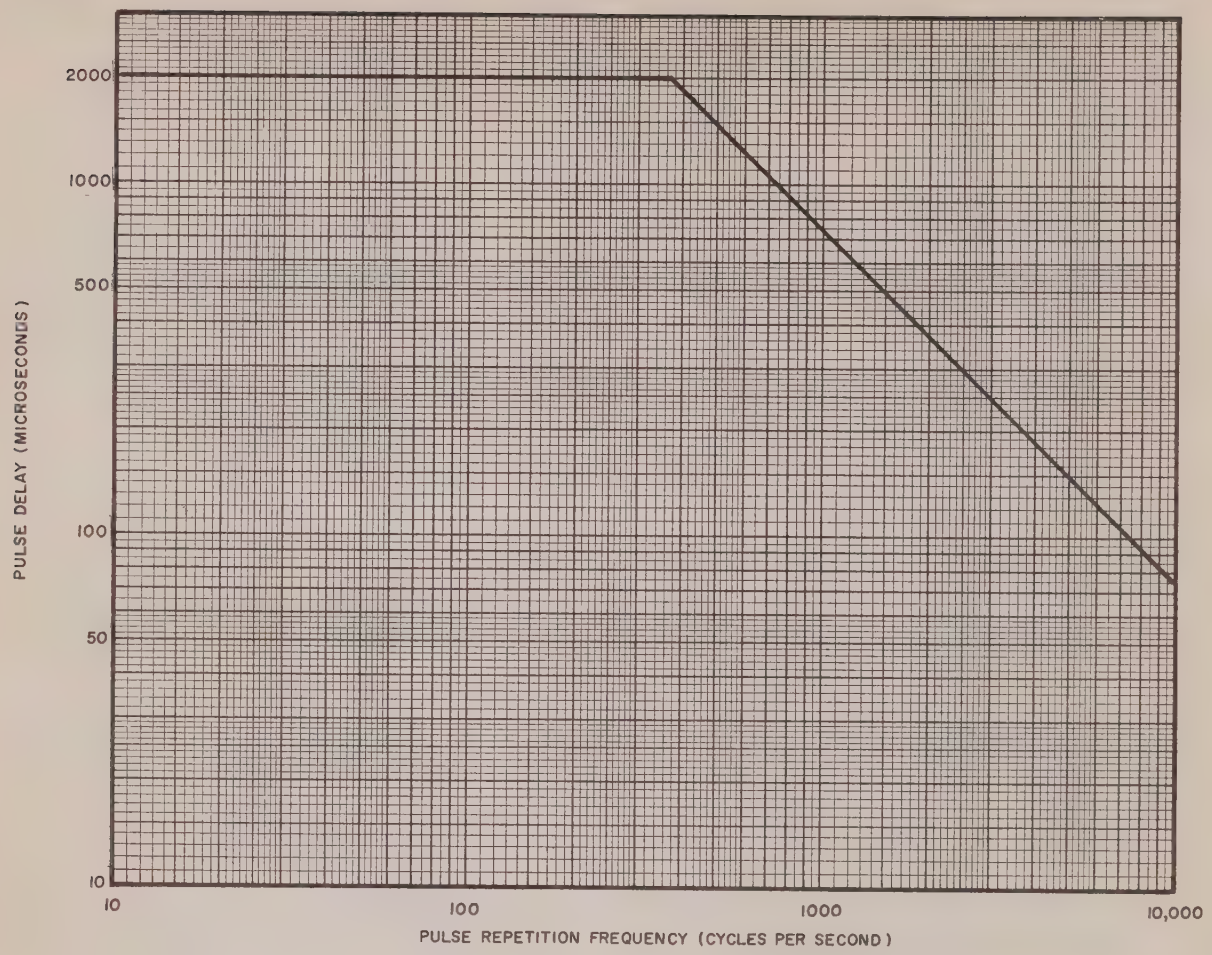


Figure 2-4. Maximum Pulse Delay Versus Repetition Rate

2-8. STARTING PROCEDURE (Cont'd).

a. Set the POWER-ON-OFF switch to OFF.

b. Determine the voltage available at the a-c power source outlet to be used.

c. Remove the Model MSG-34 from its dust cover and set 115/230V switch S2 located on a bracket on the left side of the basic unit to the position corresponding to the supply voltage. Replace the Model MSG-34 into its dust cover and secure the two to each other.

d. Connect the female end of the supplied 10-ft polarized power cable assembly to POWER INPUT 115V, 50-60 CPS receptacle located on front panel of the base unit.

e. Connect the male end of the power cable assembly (through the supplied power cable adapter, if necessary) to the power source outlet.

f. Set the ZERO SET control fully counterclockwise.

g. Set the POWER-ON-OFF switch to POWER ON. The POWER indicator will immediately become illuminated indicating that primary power is being supplied to the power transformers in the basic unit power supply.

h. After a 60-second delay, the KLYSTRON indicator will light, indicating that the beam supply is energized.

i. Allow the Model MSG-34 to warm up and stabilize for at least 15 minutes before using the equipment.

2-9. OPERATING PROCEDURES. The multiple modulation and synchronizing capabilities of the MSG-34 permit its use in a variety of microwave test applications. Each modulation and synchronizing capability requires a modified operating procedure after the power level has been set at the desired frequency of operation. The procedure for setting frequency and calibrating output power is described in paragraph 2-10. The procedures for the various modes of operation are given in the paragraphs listed as follows:

Mode of Operation	Paragraph
CW (Continuous-Wave) Operation	2-11
Internally Synchronized Square-Wave-Modulated Operation	2-12
Internally Synchronized Pulse-Modulated Operation	2-13
Externally Synchronized Pulse-Modulated Operation	2-14
External Pulse-Modulated Operation	2-15
Internally Synchronized FM Operation	2-16
External Frequency Modulation Operation	2-17
Stopping Procedures	2-18

2-10. SETTING FREQUENCY AND CALIBRATING OUTPUT POWER. Operation of the Model MSG-34 requires setting of the r-f oscillator to the desired operating frequency and calibrating the r-f output power level. The procedure for setting frequency and calibrating output power is described in the following steps:

a. Rotate the RF OSC control to obtain the desired frequency of operation as indicated on the FREQUENCY KILOMEGACYCLES dial.

b. Set the MODULATOR SELECTOR switch to ZERO SET.

Note

The reflex Klystron r-f oscillator is biased beyond cutoff when the MODULATION SELECTOR switch is set to ZERO SET.

c. Adjust the ZERO SET control to obtain a power monitor meter indication of ZERO.

d. Set the MODULATION SELECTOR switch to CW.

e. Adjust the POWER SET control to obtain a power monitor meter indication of POWER SET. The Model MSG-34 is now calibrated at a one milliwatt (0 dbm) power reference level at the desired operating frequency indicated on the FREQUENCY KILOMEGACYCLES dial.

Note

When the operating frequency of the MSG-34 is altered, the entire procedure for setting the frequency and calibrating the output power level must be repeated.

Setting the MODULATION SELECTOR switch to any position other than CW (after calibrating the output power level) will be accompanied by a reduction in the indication of the power monitor meter. This signifies that the average r-f power developed, when the r-f oscillator is modulated, is less than the average r-f power developed when the r-f oscillator is generating a CW signal.

2-11. CW (CONTINUOUS-WAVE) OPERATION. To obtain a cw r-f output signal from the MSG-34, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level, as indicated on the -DBM MICROVOLTS dial.

Note

The r-f power level at the RF OUT connector is indicated in both -dbm and microvolts (into a 50-ohm load) on the -DBM MICROVOLTS dial. The upper scale of the dial is calibrated to read -dbm and the lower scale to read microvolts.

c. Connect the 6-foot r-f cable supplied between the RF OUT connector and the equipment under test.

2-12. INTERNALLY SYNCHRONIZED SQUARE-WAVE-MODULATED OPERATION. To obtain an internally synchronized square-wave-modulated r-f output from the MSG-34, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level, as indicated on the -DBM MICROVOLTS dial.

Note

The peak power level of the square-wave-modulated r-f output signal appearing at the RF OUT connector is indicated on the -DBM MICROVOLTS dial.

c. Set the MODULATION SELECTOR switch to INT SQ WV.

d. Set the SYNC SELECTOR switch to INT.

e. Adjust the RATE CYCLES/SECOND control and RATE CYCLES/SECOND multiplier switch to obtain the desired repetition rate.

f. Adjust the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch to obtain the desired delay between the undelayed sync output pulse and both the delayed sync output pulse and the leading edge of the pulse-modulated r-f output signal.

Note

The maximum delay between the undelayed sync output pulse and the delayed sync output pulse, the latter being coincident with the leading edge of the r-f output pulse, is limited by circuit design to 2,000 microseconds or 75% of the pulse period whichever is smaller. Adjustment of the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch for delayed sync output pulses of greater delay will result in false indications. (See Figure 2-4.)

g. Connect the 6-foot r-f cable supplied between the RF OUT connector and the equipment under test.

h. Couple the DELAYED SYNC OUT connector and/or the UNDELAYED SYNC OUT connector, as required to the equipment under test and/or auxiliary test equipment.

2-13. INTERNALLY SYNCHRONIZED PULSE-MODULATED OPERATION. To obtain an internally synchronized pulse-modulated r-f output signal from the MSG-34, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level, as indicated on the -DBM MICROVOLTS dial.

Note

The peak power level of the pulse-modulated r-f output signal appearing at the RF OUT connector is indicated on the -DBM MICROVOLTS dial.

c. Set the MODULATION SELECTOR switch to INT PULSE.

d. Set the SYNC SELECTOR switch to INT.

e. Adjust the RATE CYCLES/SECOND control and RATE CYCLES/SECOND multiplier switch to obtain the desired pulse repetition rate.

f. Adjust the PULSE WIDTH MICROSECONDS control to obtain the desired pulse width.

g. Adjust the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch to obtain the desired delay between the undelayed sync output pulse and both the delayed sync output pulse and the leading edge of the pulse-modulated r-f output signal.

Note

The maximum delay between the undelayed sync output pulse and the delayed sync output pulse, the latter being coincident with the leading edge of the modulated r-f output pulse, is limited by circuit design to 2,000 microseconds or 75% of the pulse period, whichever is smaller. Adjustment of the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch for delayed sync output pulses of greater delay will result in false indications. (See figure 2-4.)

h. Connect the 6-foot r-f cable suppled between the RF OUT connector and the equipment under test.

i. Couple the DELAYED SYNCOUT connector and/or the UNDELAYED SYNCOUT connector, as required, to the equipment under test and/or auxiliary test equipment.

2-14. EXTERNALLY SYNCHRONIZED PULSE-MODULATED OPERATION. To obtain an externally synchronized pulse-modulated r-f output from the MSG-34, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level, as indicated on the -DBM MICROVOLTS dial.

Note

The peak power level of the pulse-modulated r-f output signal appearing at the RF OUT connector is indicated on the -DBM MICROVOLTS dial.

c. Set the MODULATION SELECTOR switch to INT PULSE.

d. Set the SYNC SELECTOR switch to either +EXT or SINE -EXT, as determined by the nature of the external synchronizing signal.

e. Adjust the PULSE WIDTH MICROSECONDS control to obtain the desired pulse width.

f. Adjust the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch to obtain the desired delay between the undelayed sync output pulse and both the delayed sync output pulse and the leading edge of the externally synchronized pulse-modulated r-f output pulse.

Note

The maximum delay between the undelayed sync output pulse and the delayed sync output pulse, the latter being coincident with the leading edge of the modulated r-f output pulse, is limited by circuit design to 2,000 microseconds or 75% of the pulse period, whichever is smaller. Adjustment of the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch for delayed sync output pulses of greater delay will result in false indications. (See figure 2-4.)

g. Couple the source of the external synchronizing signal to the EXT SYNC connector.

h. Connect the 6-foot r-f cable supplied between the RF OUT connector and the equipment under test.

i. Couple the DELAYED SYNC OUT connector and/or the UNDELAYED SYNC OUT connector, as required, to the equipment under test and/or auxiliary test equipment.

2-15. EXTERNAL PULSE-MODULATED OPERATION. To obtain an externally controlled pulse-modulated r-f output from the MSG-34, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level, as indicated on the -DBM MICROVOLTS dial.

Note

The peak power level of the externally controlled pulse-modulated r-f output signal appearing at the RF OUT connector is indicated on the -DBM MICROVOLTS dial.

c. Set the MODULATION SELECTOR switch to EXT MOD.

d. Set the SYNC SELECTOR switch to either +EXT or SINE -EXT, as determined by the nature of the externally supplied modulating pulse.

e. Couple the source of the externally supplied modulating pulse to the EXT MOD connector.

f. Connect the 6-foot r-f cable supplied between the RF OUT connector and the equipment under test.

2-16. INTERNALLY SYNCHRONIZED FM OPERATION. To obtain an internally synchronized frequency-modulated r-f pulse train from the MSG-34, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level, as indicated on the -DBM MICROVOLTS dial.

Note

The peak power level of the frequency-modulated r-f output pulse appearing at the RF OUT connector is indicated on the -DBM MICROVOLTS dial.

c. Set the MODULATION SELECTOR switch to FM.

d. Set the SYNC SELECTOR switch to INT.

e. Adjust the RATE CYCLES/SECOND control and the RATE CYCLES/SECOND multiplier switch to obtain the desired repetition rate.

f. Adjust the FM AMP control to obtain the desired frequency excursion of the modulated signal. The extreme clockwise setting of the FM AMP control produces a total frequency excursion of at least 5 mc.

Note

The maximum delay between the undelayed sync output pulse and the delayed sync output pulse, the latter being coincident with the leading edge of the modulated r-f output pulse, is limited by circuit design to 2,000 microseconds or 75% of the pulse period, whichever is smaller. Adjustment of the DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch for delayed sync output pulses of greater delay will result in false indications.(See figure 2-4.)

g. Connect the 6-foot r-f cable supplied between the RF OUT connector and the equipment under test.

h. Couple the DELAYED SYNC OUT connector

and/or the UNDELAYED SYNC OUT connector, as required, to the equipment under test and/or auxiliary test equipment.

2-17. EXTERNAL FREQUENCY-MODULATION OPERATION. To obtain an externally controlled frequency-modulation r-f output from the Model MSG-34, proceed as outlined in the following steps:

a. With the Model MSG-34 in an operative state (refer to paragraph 2-8), calibrate the power level as outlined in paragraph 2-10.

b. Adjust the ATTENUATOR control to obtain the desired r-f output level as indicated on the -DBM MICROVOLTS dial.

Note

The peak power level of the externally controlled frequency-modulation r-f output signal appearing at the RF OUT connector is indicated on the -DBM MICROVOLTS dial.

c. Set the MODULATION SELECTOR switch to EXT MOD.

d. Set the SYNC SELECTOR switch to EXT FM.

e. Couple the source of the externally supplied frequency-modulation signal to the EXT MOD connector.

f. Connect the r-f cable supplied between the RF OUT connector and the equipment under test.

2-18. STOPPING PROCEDURES. To shut down the MSG-34, simply set the POWER-ON-OFF switch to OFF. Both the POWER and KLYSTRON indicators will immediately go out when operating power is removed from the unit.

Note

As an added precaution against possible damage to the Model MSG-34 or the equipment in the test setup, set the MODULATION SELECTOR switch to ZERO SET after the POWER-ON-OFF switch has been set to OFF.

2—19. PACKAGING INSTRUCTIONS.

2-20. PACKAGING FOR SHORT-TERM STORAGE. If the Model MSG-34 is to be stored for a relatively short period, cover it with a suitable protective covering such as a sheet of plastic or paper. Put the accessories and instruction manual in a carton or bag and fasten it to the unit to prevent loss. Store the Model MSG-34 in a clean dry area where it will not be subject to extreme temperatures.

2-21. PACKAGING FOR LONG-TERM STORAGE OR SHIPMENT. If the Model MSG-34 is to be stored for a long period of time, or shipped, proceed as follows:

a. If the original wrappings and carton have been saved, use them to package the equipment as shown in Figure 2-5.

b. If new packing materials are to be used, assemble the necessary wrappings and carton.

c. Wrap the equipment in a moisture and vapor-proof barrier such as plastic or waterproof paper.

d. Wrap the accessories and instruction manual in a moisture and vapor-proof barrier.

e. Place the package in a suitable carton. Fill all empty spaces in the carton with suitable packing to prevent shifting of the packages within the carton.

f. Seal and mark the carton.

g. If the storage or shipping conditions make it necessary, enclose the carton within an outer carton or wooden box.

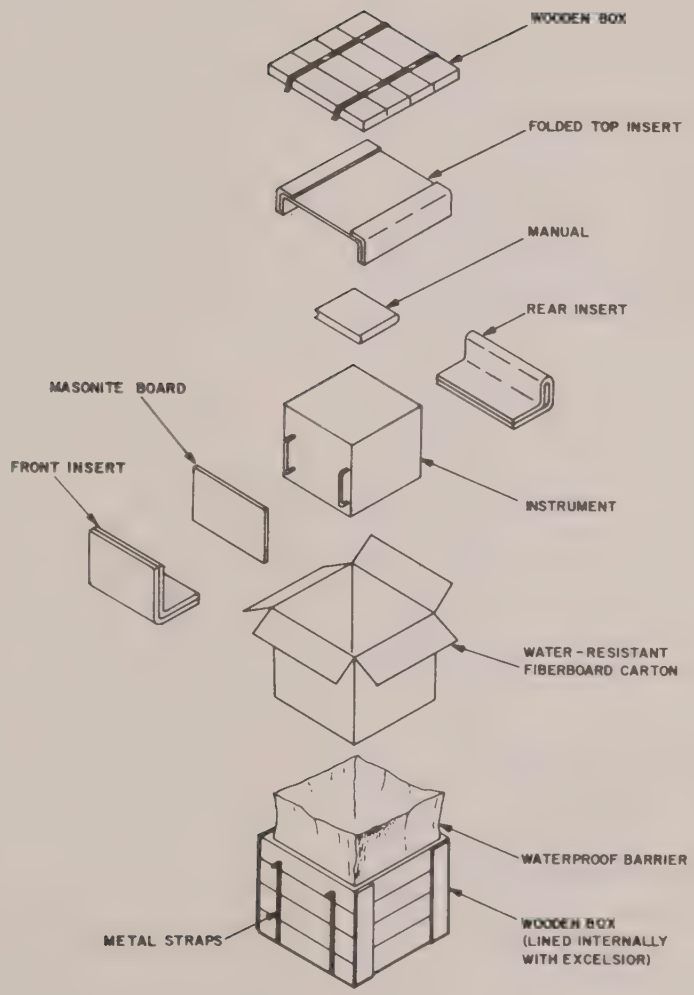


Figure 2-5. Packaging Diagram

SECTION III
THEORY OF OPERATION

3—1. GENERAL.

3-2. The Model MSG-34 Microwave Signal Generator is a precision instrument capable of generating low-power continuous-wave (cw), frequency-modulated, square-wave-modulated, and pulse-modulated r-f signals of known intensity over the frequency range from 4,200 to 11,000 mc. In addition to providing r-f test signals at the equipment front panel RF OUT connector, the MSG-34 also provides delayed and undelayed positive video trigger pulses for application to external test equipment. These pulses are available at the DELAYED SYNC OUT and UNDELAYED SYNC OUT connectors, respectively, when the MSG-34 is programmed for internally synchronized frequency-modulated, square-wave-modulated, or pulse-modulated operation and externally synchronized pulse-modulated operation.

3—3. SIMPLIFIED BLOCK DIAGRAM ANALYSIS.

3-4. The MSG-34 consists of a modulator, keyer, reflex klystron r-f oscillator, power monitor, and the necessary power supplies, as shown in Figure 3-1. The modulator generates the required pulsed signals to the keyer, which, in turn, couples these signals to the control grid of the reflex klystron r-f oscillator, thereby permitting oscillations at the desired intervals and repetition rates. Frequency modulation of the reflex klystron r-f oscillator is accomplished by sweeping the repeller with a sawtooth waveform developed within the modulator. A portion of the r-f power developed by the r-f oscillator is applied to a thermistor bridge network as a means of calibrating the r-f output power level.

3—5. DETAILED BLOCK DIAGRAM ANALYSIS.

3-6. ZERO SET OPERATION. When MODULATION SELECTOR switch S203 is in the ZERO SET position (see figure 3-2), the modulator section of the MSG-34 is unenergized and a negative potential is applied to the control grid of reflex klystron r-f oscillator V102. This negative potential is sufficient to drive the tube beyond cutoff and permits the operator to balance the thermistor bridge by adjusting ZERO SET control R51.

3-7. CW OPERATION. When MODULATION SELECTOR switch S203 is in the CW position (see figure 3-2), the modulator section of the MSG-34 is unenergized, as in ZERO SET operation. The voltage applied to the control grid of reflex klystron r-f oscillator V102, however, permits oscillation. The output level of the r-f signal is calibrated at one milliwatt by adjusting the POWER SET control until the power monitor meter pointer deflects to an indication of POWER SET. The r-f power level available at the RF OUT connector is then determined by the setting of the ATTENUATOR control.

3-8. FM OPERATION. When the MODULATION SELECTOR switch is in the FM position and SYNC SELECTOR switch S201 is in the INT position (see figure 3-2), a square-wave signal and a sawtooth signal are simultaneously developed by a rate generator (V201, V202, and V203) within the modulator section. The square-wave signal is coupled to the control grid of the reflex klystron r-f oscillator, alternately permitting it to conduct (oscillate) and driving it beyond cutoff. Simultaneous application of the sawtooth signal to the repeller electrode of the oscillator results in a frequency-modulated square-wave r-f pulse at the RF OUT connector. The magnitude of the sawtooth signal, and hence the frequency excursion of the frequency-modulated pulse, is adjusted by FM AMP control R201.

3-9. INTERNAL PULSE OPERATION. When the MODULATION SELECTOR switch is in the INT PULSE position and the SYNC SELECTOR switch is in the INT position (see figure 3-2), the square-wave signal appearing at the screen grid of phantastron rate generator V201 is coupled to width multivibrator V211 through the delay circuitry (refer to paragraph 3-13). Width multivibrator V211 produces a pulse, the width being determined by the setting of PULSE WIDTH MICROSECONDS control R316, that is coupled via cathode follower V210, video amplifier V107, and keyer amplifier V108 to the control grid of reflex klystron r-f oscillator V102.

3-10. INTERNAL SQUARE-WAVE OPERATION. When MODULATION SELECTOR switch S203 is in the INT SQ WV position, and SYNC SELECTOR switch S201 is in the INT position (see figure 3-2) the square wave output of coupling amplifier V202A is applied through video amplifier V107 and keyer amplifier V108 to the control grid of reflex klystron V102 resulting in a square-wave-modulated output at RF OUT connector J101. The output of the rate generator V201, V202, and V203 is also applied to the delay circuitry where undelayed and delayed synchronizing video output pulses are developed for application to UNDELAYED SYNC OUT connector J203 and DELAYED SYNC OUT connector J204, respectively.

3-11. EXTERNAL MODULATION. Provision for external pulse modulation is made by EXT MOD jack J205 and associated circuitry. When MODULATION SELECTOR switch S203 is in the EXT MOD position and SYNC SELECTOR switch S201 is in the +EXT or SINE -EXT position (see figure 3-2), depending on the polarity of the externally applied modulating pulse, the externally applied modulating signal is coupled through video amplifier V107 and keyer amplifier V108 to the control grid of reflex klystron r-f oscillator V102.

3-12. EXTERNAL FREQUENCY MODULATION. When MODULATION SELECTOR switch S203 is in the EXT MOD position and SYNC SELECTOR switch S201 is in the EXT FM position an external signal is applied through EXT MOD connector J205 to the repeller of reflex klystron r-f oscillator V102, thereby frequency-modulating the output signal.

3-13. INTERNAL SYNCHRONIZATION. When SYNC SELECTOR switch S201 is in the INT position and MODULATION SELECTOR switch S203 is in the INT PULSE position (see figure 3-2), the square-wave signal appearing at the screen grid of phantastron rate generator V201 is coupled through puller amplifier V209A and undelayed sync blocking oscillator V209B, the latter producing a positive video trigger pulse which is available at UNDELAYED SYNC OUT connector J203. The output of undelayed sync blocking oscillator V209B is also coupled to delay phantastron V205, which, in conjunction with DELAY MICROSECONDS control R234, DELAY MICROSECONDS multiplier switch S204, and cathode follower V204A, delays the video trigger pulse. This delayed pulse is coupled through buffer amplifier V204B to blocking oscillator V206A. The output of V206A is then coupled to width multivibrator V211 and to delayed sync blocking oscillator V206B. Blocking oscillator V206A shapes the signal into a positive delayed trigger pulse which is available at DELAYED SYNC OUT connector J204. The rectangular pulse output of V211 is applied through cathode follower V210, video amplifier V107 and keyer amplifier V108 to the control grid of reflex klystron r-f oscillator V102.

3-14. When MODULATION SELECTOR switch S203 is in the INT SQ WV position, the square wave output signal of rate generator V201, V202 and V203 is applied through video amplifier V107 and keyer amplifier V108 to the control grid of reflex klystron r-f oscillator V102.

3-15. Setting MODULATION SELECTOR switch S203 in the FM position couples the square wave output signal of the rate generator (as in internally synchronized square wave operation) through video amplifier V107 and keyer amplifier V108 to the control grid of the reflex klystron r-f oscillator V102. In addition, a sawtooth signal developed at the plate of V201 is coupled through FM AMP control R201 to the repeller of reflex klystron r-f oscillator V102. This sawtooth voltage is superimposed on the repeller voltage, thus producing a frequency modulated output at RF OUT connector J101.

3-16. EXTERNAL SYNCHRONIZATION. External triggering of the modulator circuit is accomplished by applying an external synchronization signal to EXT SYNC connector J202. With the SYNC SELECTOR switch S201 in the +EXT or SINE -EXT position (depending on the nature of the externally applied synchronization signal) and the MODULATION SELECTOR switch S203 in the INT PULSE position, the externally applied sync signal triggers width multivibrator V211 through the delay and pulse shaping circuitry (see paragraph 3-13). Video trigger pulses are also available at UNDELAYED SYNC OUT connector J203 and at DELAYED SYNC OUT connector J204. The rectangular output pulse of width multivibrator V211 is coupled through cathode follower V210, video amplifier V107, and keyer amplifier V108 to the control grid of reflex klystron r-f oscillator V102.

3-17. When MODULATION SELECTOR S203 is in the INT SQ WV or FM position and SYNC SELECTOR switch S201 is in the +EXT or SINE-EXT position, the output of delayed sync blocking oscillator V206 triggers the rate generator and a square wave is applied through video amplifier V107 and keyer amplifier V108 to the control grid of reflex klystron r-f oscillator V102.

3—18. DETAILED CIRCUIT ANALYSIS, MODULATOR SECTION.

3-19. Paragraphs 3-20 through 3-42 contain a detailed analysis of the various circuits of the modulator section.

3-20. RATE GENERATOR V201, V202, AND V203. The rate generator (see figure 5-1) consists of two phantastron circuits connected back-to-back (V201 and V203) through two coupling amplifiers (V202A and V202B). The operation of the four circuits comprising the rate generator are dependent upon each other and are therefore considered simultaneously as a free-running oscillator.

3-21. The rate generator provides the necessary modulator output signals required for internal frequency-modulated, internal pulse-modulated, and internal square-wave-modulated operation of the MSG-34. The variety and linearity of the waveshapes associated with the rate generator make it adaptable to furnish the requirements of these three modes of operation.

3-22. The waveshapes associated with the rate generator can best be described by considering the conditions that exist throughout the circuit during any particular period of time. Let phantastron rate generator V201 be considered initially in the off state due to a negative voltage on its suppressor grid. This negative voltage is derived from the combination of a positive potential appearing at the plate of coupling amplifier V202A and the -108 volt supply. At this instant of time the plate of V201 is at +210 volts (plate supply voltage). The screen electrode is at some lower potential due to its intercepting cathode current and acting as a plate. The control grid of V201 is clamped to ground at this period of time because of its connection to the plate supply through resistor R202, Sq Wv Symmetry Adj control R211, and RATE CYCLES/SECOND control R212.

3-23. The negative potential at the suppressor is directly coupled to the control grid of coupling amplifier V202B, causing the tube to draw a small value of plate current. The plate voltage of V202B is therefore less than the plate supply voltage. The combination of the positive potential from the plate of V202B and the negative potential from the -108 volt supply produces a slightly positive potential on

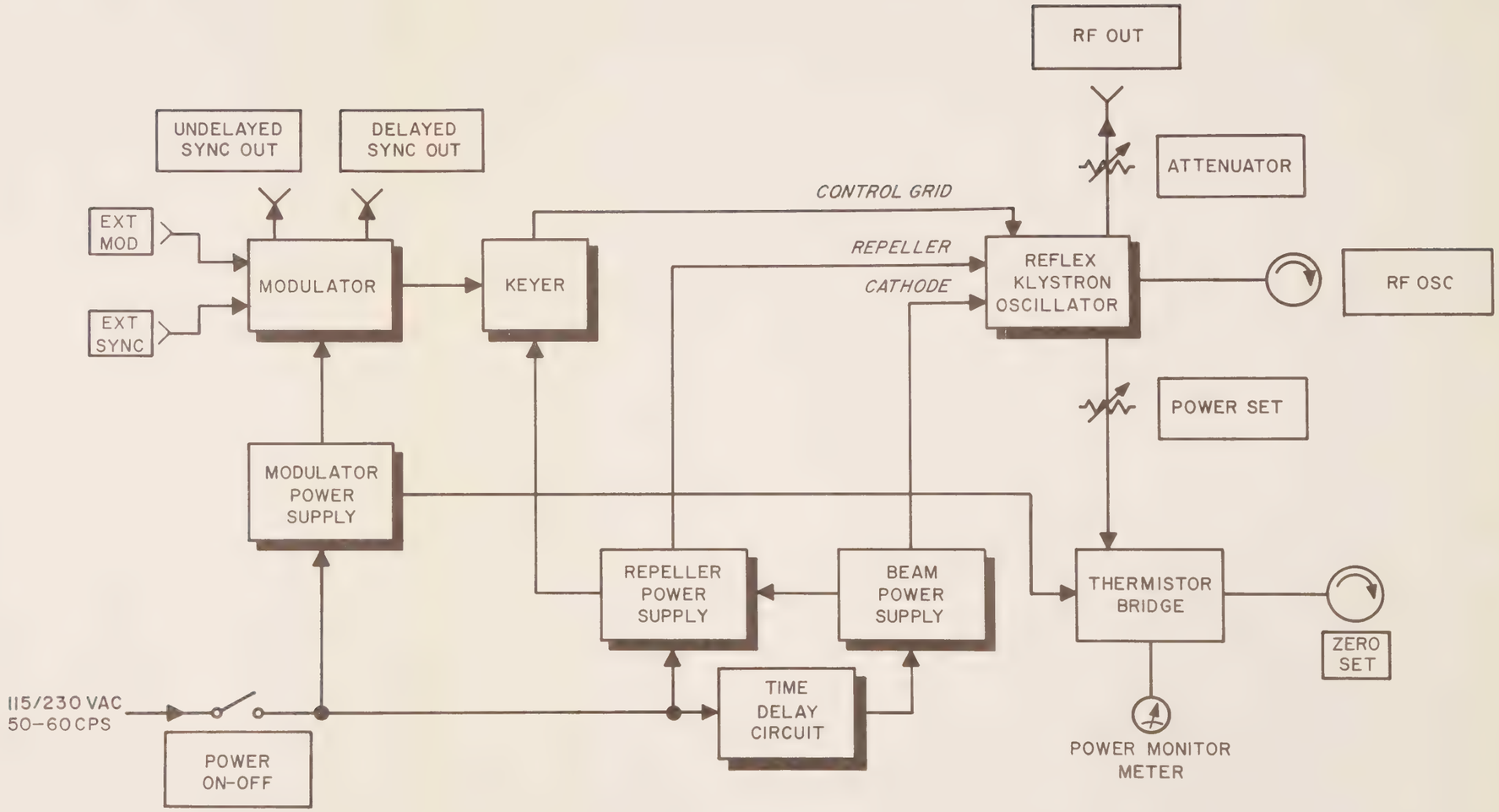
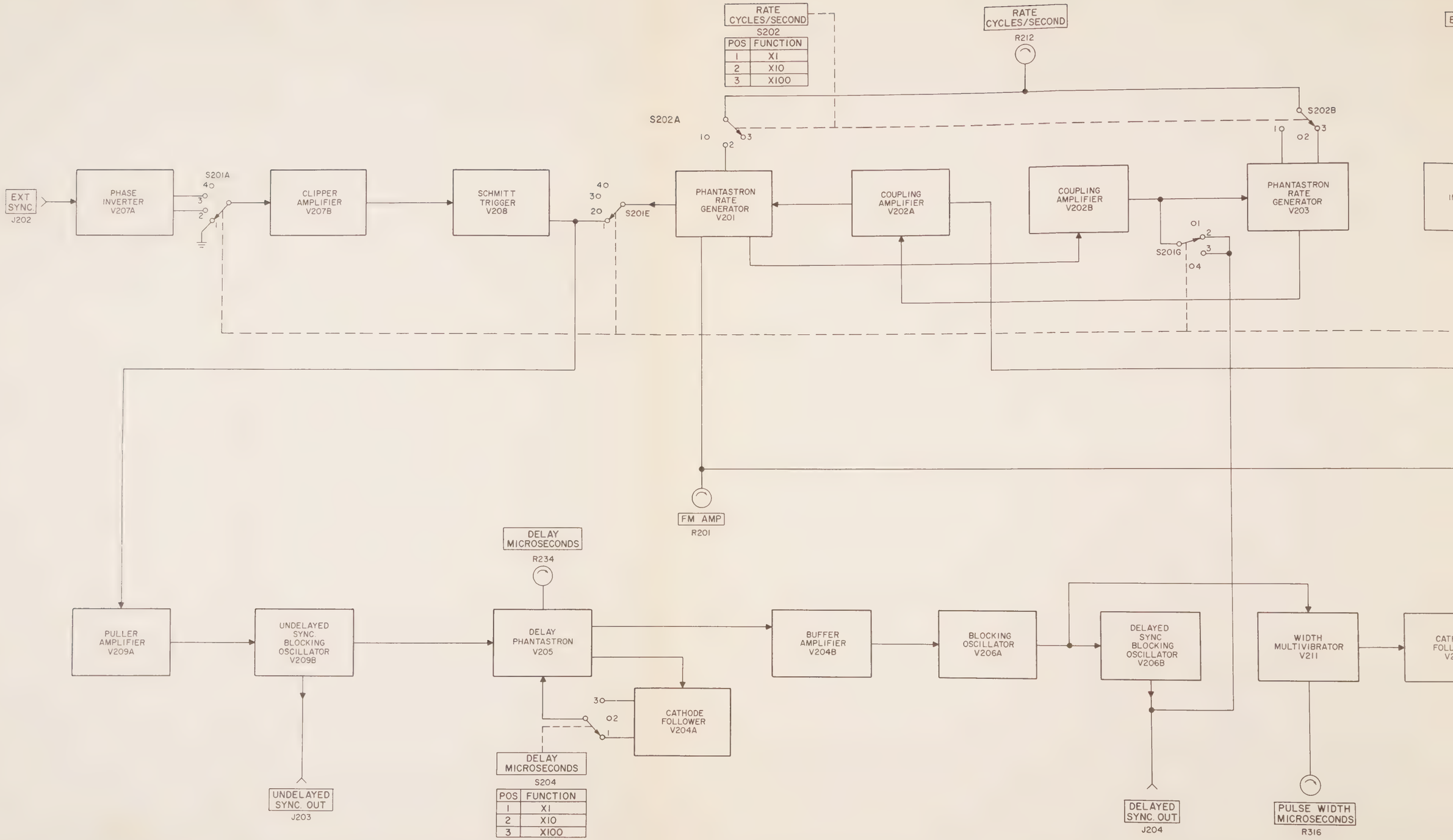


Figure 3-1. Model MSG-34 Microwave Signal Generator, Simplified Block Diagram


RATE CYCLES/SECOND
S202
POS FUNCTION
1 X1
2 X10
3 X100
RATE CYCLES/SECOND
R212
S202A
S202B
EXT SYNC.
J202
PHASE INVERTER V207A
S201A
CLIPPER AMPLIFIER V207B
SCHMITT TRIGGER V208
S201E
PHANTASTRON RATE GENERATOR V201
COUPLING AMPLIFIER V202A
COUPLING AMPLIFIER V202B
PHANTASTRON RATE GENERATOR V203
S201G
FM AMP
R201
DELAY MICROSECONDS
R234
PULLER AMPLIFIER V209A
UNDELAYED SYNC. BLOCKING OSCILLATOR V209B
DELAY PHANTASTRON V205
BUFFER AMPLIFIER V204B
BLOCKING OSCILLATOR V206A
DELAYED SYNC BLOCKING OSCILLATOR V206B
WIDTH MULTIVIBRATOR V211
CATHODE FOLLOWER V204A
UNDELAYED SYNC. OUT
J203
DELAY MICROSECONDS
S204
POS FUNCTION
1 X1
2 X10
3 X100
DELAYED SYNC. OUT
J204
PULSE WIDTH MICROSECONDS
R316

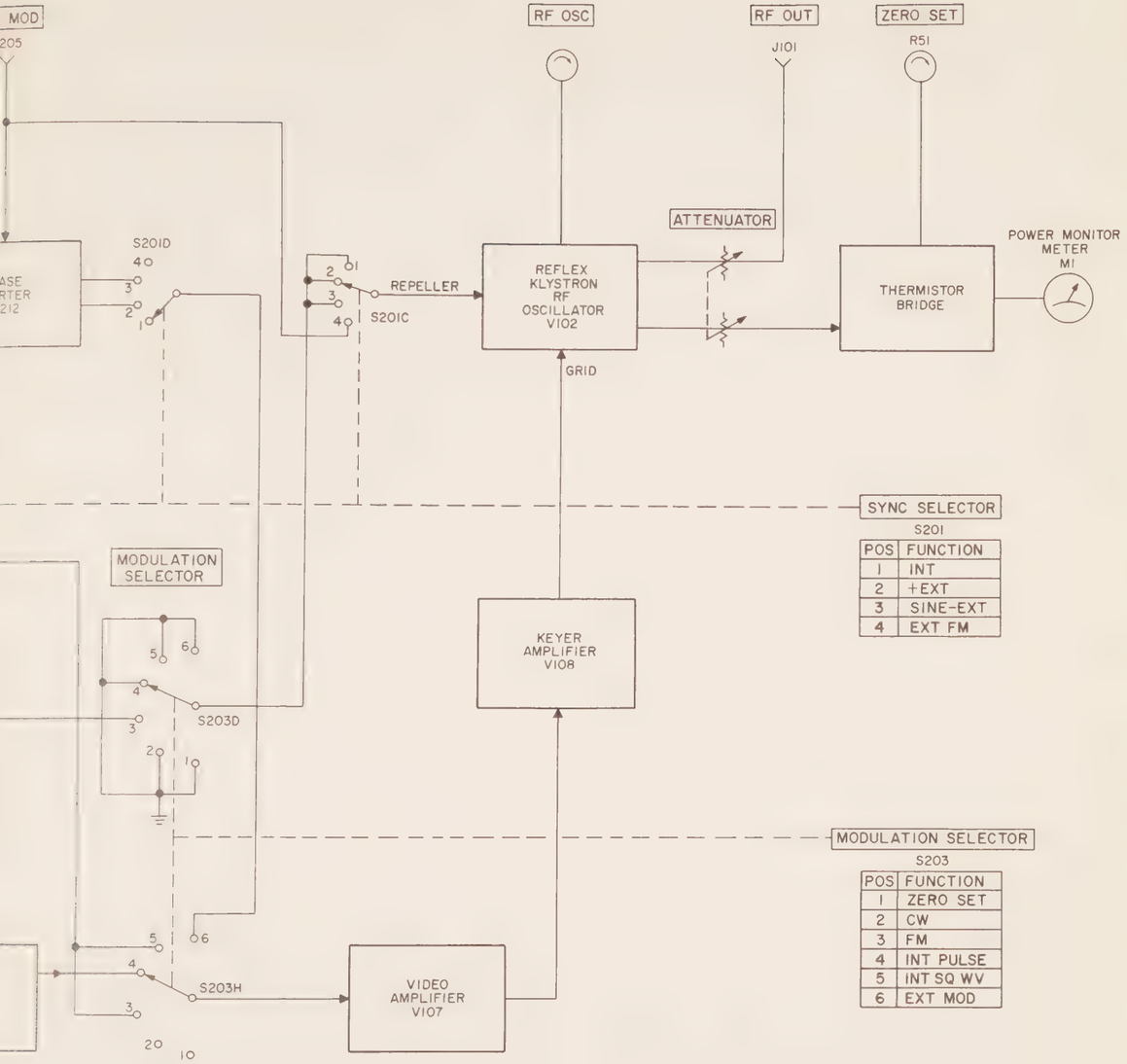


Figure 3-2. Model MSG-34, Microwave Signal Generator, Detailed Block Diagram

the suppressor grid of phantastron rate generator V203.

3-24. This positive voltage allows the plate of V203 to draw current and the plate voltage drops, beginning its "run down." This run-down period, or linear fall in voltage, is due to the capacitive feedback between the plate and control grid. The feedback capacitor tries to rise to the plate supply voltage through R211 and R212, causing the plate potential to drop. This decrease in plate voltage is transmitted to the control grid, resulting in a gradual rise in grid voltage and a rapid fall in plate voltage. During this time the screen grid potential remains essentially constant until the plate of V203 reaches its lowest possible potential, thereby permitting the control grid of V203 to suddenly rise to a positive potential.

3-25. The result is a slight overshoot at the grid of V203, which falls back to zero due to the grid clamping. The plate gradually rises to the plate supply voltage and the screen voltage drops because of the increase in screen current, causing the suppressor voltage to drop correspondingly. The drop in the suppressor voltage of V203 is coupled to the suppressor of V201 through coupling amplifier V202A, resulting in a rise in potential at the suppressor of V201. Now phantastron rate generator V201 is on and its plate begins its "run down" until V203 is again turned on. The "run down" time of both phantastron rate generators is controlled by the value of the feedback capacitors and the value of the voltage tapped from the +210 volt supply. The former is determined by the setting of RATE CYCLES/SECOND multiplier switch S202, which permits multiplying the repetition rate by factors of 1, 10, or 100. The latter is adjusted by RATE CYCLES/SECOND control R212.

3-26. PULLER AMPLIFIER V209A. Puller amplifier V209A (see figure 5-1) is a conventional grounded-cathode amplifier operating class A with a fixed grid bias. The voltage divider network consisting of resistors R204 and R281, in conjunction with the -108 volt supply, provides a bias voltage of approximately -6 volts, thereby placing the tube in the linear portion of its characteristics. The plate circuit contains one winding of feedback transformer T202 and a plate load resistor, R290, both shared by puller amplifier V209A and undelayed sync blocking oscillator V209B. A square pulse of approximately 200 volts peak-to-peak amplitude is differentiated by C204, R206, R204, and R281. The pulse that appears at the grid of V209A is a sharp negative spike of approximately 35 volts amplitude. The positive portion of the pulse is shorted by the grid clamping action of CR203, R213, and C216. The negative spikes are attenuated by the grid circuit resistors and the internal impedance of the pulse source. The positive pulse appearing at the plate of puller amplifier V209A is directly connected to the plate of V209B.

3-27. UNDELAYED SYNC BLOCKING OSCILLATOR V209B. Undelayed sync blocking oscillator V209B (see figure 5-1) receives the positive pulses from the plate of puller amplifier V209A and transforms them into short-duration positive pulses. These pulses are then presented to UNDELAYED SYNC OUT connector J203 and, simultaneously, to the suppressor of delay phantastron V205.

3-28. V209B operates with a fixed bias provided by the -108 volt supply and the voltage divider network composed of resistors R287 and R284. Capacitor C233 charges to a constant voltage of approximately -13 volts and offers a low impedance to ground for any pulse appearing at the grid. The positive pulses at the plates, pins 1 and 9, of V209 are coupled to the grid circuit of V209B through transformer T202. T202 inverts the polarity of the signal by virtue of the manner in which it is wound, and the signal appears as a negative pulse at the grid. A condition is therefore imposed such that a fall in plate voltage is accompanied by a rise in grid voltage, which demands an additional drop in plate voltage. This action is cumulative until the plate bottoms, or saturates, and no additional plate current can be drawn. No change in plate current exists and, therefore, no flux linkage to induce the signal into the grid circuit. At this point the plate begins to rise and the grid is forced to fall correspondingly. The plate potential rises beyond the plate supply voltage because of the inductive characteristics of transformer T202, which behaves like an open-circuit when it is first presented with a fast-rising function. The impedance of the transformer gradually falls and the result is an overshoot, which is depicted in figure 3-3. The output, however, is taken at the cathode, thereby presenting a low-impedance positive pulse to UNDELAYED SYNC OUT connector J203. The cathode pulse is also differentiated, clipped, and applied to the control grid of delay phantastron V205.

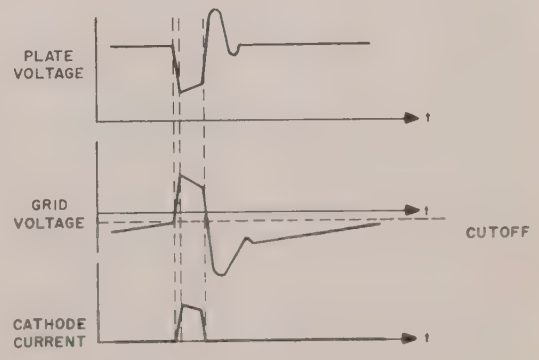


Figure 3-3. Waveforms, Undelayed Sync Blocking Oscillator V209B

3-29. DELAY PHANTASTRON V205 AND CATHODE FOLLOWER V204A. Delay phantastron V205 (see figure 5-1) functions as a normally off sweep generator which responds to a positive pulse applied to its suppressor grid. Cathode follower V204A is utilized to speed up the recovery time with no increase in gain or phase inversion. The suppressor of V205 is maintained at a negative potential through R230 and R229 and the -108 volt supply.

3-30. The trigger at the cathode of V209B is coupled to the suppressor of delay phantastron V205, which is a screen-coupled phantastron circuit with a speed-up cathode follower. The positive trigger applied to the suppressor allows the plate to draw current. The plate voltage drops, the grid voltage drops proportionally, the cathode current falls, and the screen voltage rises. This causes the suppressor voltage to rise, since it is obtained from the same bleeder as the screen. The plate potential then runs down linearly as the rate generator circuit. The end of this period comes when the control grid goes positive again, resulting in an increase in cathode current, in suppressor cutoff, and heavy screen current. The delay is adjusted by varying the RC time constant and by varying the plate-clamping potential. DELAY MICROSECONDS multiplier switch S204 inserts different value capacitors into the plate-grid circuit, thereby changing the delay range. Min Delay Adj control R233 sets the minimum delay of the phantastron. Max Delay Adj control R276 sets the maximum delay of the phantastron. DELAY MICROSECONDS control R234 is the fine delay control. The maximum delay is a function of the recovery capabilities of the phantastron circuit (see figure 2-4).

3-31. The delayed pulse is taken off the suppressor of V205 and applied to the control grid of buffer amplifier V204B through the grid bias voltage divider network consisting of resistors R229 and R230.

3-32. BUFFER AMPLIFIER V204B. Buffer amplifier V204B (see figure 5-1) isolates, amplifies, inverts, and differentiates the output of delay phantastron V205. The grid is held to a fixed negative potential by the -108 volt supply and the resistor network comprised of R229 and R230. A positive pulse from the suppressor of V205 is applied to the grid of V204B. The signal developed at the plate is somewhat irregular and is composed of large amplitude positive and negative spikes. The plate pulse is influenced by inductor L201, which forms a differentiator network with the plate resistance of the tube. The positive and negative spikes at the plate both appear in time at the trailing edge of the input pulse. The negative spike corresponds to the leading edge of the input pulse and the positive spike corresponds to the trailing edge, due to the inversion property of the tube. The output pulse at the plate is coupled to blocking oscillator V206A through C217, R237, R238, and R317, which form a differentiator network.

3-33. BLOCKING OSCILLATOR V206A. Blocking oscillator V206A (see figure 5-1) is a conventional type fixed bias blocking oscillator which produces short-duration positive pulses to trigger both width multivibrator V211 and delayed sync blocking oscillator V206B. The grid bias is provided by the -108 volt supply and the divider network made up of R237, R238, and R317. The bias level can be adjusted by Bias Adj control R238. The output signal is developed in the same manner as previously described for the undelayed sync blocking oscillator in paragraph 3-28. The output is taken from the cathode, which provides a low impedance pulse source to trigger width multivibrator V211 and delayed sync blocking oscillator V206B.

3-34. DELAYED SYNC BLOCKING OSCILLATOR V206B. Delayed sync blocking oscillator V206B (see figure 5-1) provides short-duration positive pulses to DELAYED SYNC OUT connector J204. V206B is held below cutoff with a fixed negative potential tapped from the -108 volt supply through R244 and R246. The oscillator is triggered by the positive pulse from the cathode of V206A and the output pulse is developed in the same manner as described for the undelayed sync blocking oscillator in paragraph 3-28. The output pulse is coincident with the leading edge of the modulated pulse output and can be delayed from 2 to 2,000 microseconds.

3-35. WIDTH MULTIVIBRATOR V211. Width multivibrator V211 (see figure 5-1) is a monostable multivibrator which produces positive pulses adjustable in width from 0.2 to 10 microseconds. The output pulse is coupled to cathode follower V210 to the video amplifier V107 and keyer amplifier V108 and modulates the control grid of the reflex klystron r-f oscillator V102.

3-36. In the stable state of this multivibrator, V211A is cut-off and V211B is fully on. A trigger from blocking oscillator V206A is differentiated by C241 and R307 and applied to the grid of V211A through CR212, which is always reversed biased by the existing voltages across R309 and R308. Only a trigger large enough to forward bias CR212 for the duration of the trigger will pass through to be applied to the grid of V211A. This applied trigger brings V211A into conduction, causing an abrupt drop at its plate. Since the grid of V211B is a-c coupled to the plate of V211A, it will also drop abruptly. This is accompanied by a sharp rise in the plate voltage of V211B. The multivibrator is now in the quasi-stable state and will remain in that state until V211B comes into conduction, at which point the circuit makes a reverse transition into its stable state. V211B stays cutoff as long as the voltage at its grid is sufficiently negative to prevent conduction. The duration of time V211B is cutoff is determined by PULSE WIDTH MICROSECONDS control R316 and Min Width Adj control R315. A positive pulse appears at the plate of V211B while it is cutoff. The d-c component of the pulse is filtered out by C240 and the negative portion of the averaged wave is clipped by CR213. This rectangular positive pulse is applied to cathode follower V210.

3-37. CATHODE FOLLOWER V210. Cathode follower V210 (see figure 5-1) provides a low impedance pulse source which couples the output of width multivibrator V211 to video amplifier V107. The

output is taken from the cathode and is applied to video amplifier V107 when MODULATION SELECTOR switch S203 is in the INT PULSE position.

3-38. PHASE INVERTER V207A. Provision for external synchronization of the MSG-34 with a sine wave or pulse signal is made available at EXT SYNC connector J202.

3-39. Phase inverter V207A (see figure 5-1) passes a signal applied to EXT SYNC connector J202 either with or without phase inversion. SYNC SELECTOR switch S201 selects a signal either from the plate or cathode of V207A. Resistors R256 and R257 are chosen such that the gains from the plate and cathode are equal. The output of V207A, which is always a negative pulse, is applied to clipper amplifier V207B.

3-40. CLIPPER AMPLIFIER V207B. Clipper amplifier V207B (see figure 5-1) amplifies and clips the signal output from V207A. The stage is biased through cathode resistor R266. The negative amplitude of the applied trigger is sufficiently large to drive this amplifier below cutoff. The output clipping, therefore, is due to the cutoff action of V207B. Resistors R265 and R267, and capacitor C228, plus the grid-to-ground capacitance of V208A, comprise a compensated attenuator which preserves the shape of the positive input pulse. This pulse is applied to the grid of Schmitt trigger V208A, which ultimately produces the trigger pulse that synchronizes the rate generator.

3-41. SCHMITT TRIGGER V208. Schmitt trigger V208 (see figure 5-1) shapes and flattens the trigger pulse from clipper amplifier V207B. With no pulse applied to pin 2 of V208, the voltages across R267 and cathode resistor R273 are sufficient to prevent V208A from conducting. The voltage across R274 and R273 holds V208B in the conduction region. A pulse of sufficient amplitude applied to the grid of V208A will bring V208A into conduction for the duration of the pulse. As the leading edge of the pulse is applied to pin 2, V208A is brought into conduction. The plate voltage of V208A drops and, due to the a-c coupling, the voltage at pin 7 also drops. The voltage across R273 follows the voltage drop at the grid of V208B; as a result of this feedback mechanism, the grid of V208A is made more positive. This regenerative feedback, plus the applied positive voltage at pin 2, drives V208A abruptly into conduction. The abrupt drop in voltage at pin 1 cuts off V208B, which causes the plate of V208B to rise to the supply voltage value. The circuit will remain in this state for the duration of the applied pulse. When the pulse is terminated, the voltage at the grid of V208A is such as to drive it into cutoff. This causes a reverse transition to occur and the circuit is brought back to its quiescent state. The output pulse, the duration of which is equal to the time that V208B is cutoff, is applied to the control grid of puller amplifier V209A and the screen grid of phantastron rate generator V201 when MODULATION SELECTOR switch S203 is in the INT PULSE position.

3-42. PHASE INVERTER V212. The reflex klystron r-f oscillator may be externally pulse modulated using EXT MOD connector J205. A pentode phase inverter stage is provided (see figure 5-1) to couple the external signals to video amplifier V107 and keyer amplifier V108. Phase inverter V212 functions in the same manner as described in paragraph 3-39 for phase inverter V207A. When MODULATION SELECTOR switch S203 is not in the EXT MOD position, the +210 volt supply voltage is removed from the plate of V212 and the tube is inoperative. The output of V212 is taken from the plate or cathode, depending on the polarity of the input signal, and is transferred to the grid of V107.

3—43. DETAILED CIRCUIT ANALYSIS, KEYER CIRCUITS.

3-44. Paragraphs 3-45 and 3-46 contain a detailed analysis of the circuits comprising the keyer.

3-45. VIDEO AMPLIFIER V107 AND KEYER AMPLIFIER V108. Video amplifier V107 amplifies the output of cathode follower V210 when MODULATION SELECTOR switch S203 is in the INT PULSE position, and amplifies the output of coupling amplifier V202A when the MODULATION SELECTOR switch is in the FM or INT SQ WV position. In internal pulse, internal square wave and internal FM operation the modulating pulse is coupled through S203H, K101, C108, C110, K102 and applied to the control grid of V107. The output of V107 is applied through C115 and K102 to the control grid of V108. Keyer amplifier V108 is driven to cutoff for the duration of the applied pulse, thereby allowing V102 to oscillate.

3-46. When MODULATION SELECTOR switch S203 is in the EXT MOD position, external modulating pulses are applied through EXT MOD connector J205, phase inverter V212, SYNC SELECTOR switch S201D, capacitor C114, and relays K101 and K102 to the control grid of V107. The output at V107, taken at the plate is coupled through C115 and K102 to the control grid of V108. Keyer amplifier V108 is driven to cutoff for the duration of the applied pulse thereby allowing V102 to oscillate.

3—47. DETAILED CIRCUIT ANALYSIS, OSCILLATOR SECTION.

3-48. Paragraphs 3-49 through 3-59 contain a detailed circuit analysis of the r-f oscillator section of the MSG-34.

3-49. REFLEX KLYSTRON R-F OSCILLATOR V102. Reflex klystron r-f oscillator V102 (see figure 5-2) produces the r-f power output. The oscillator circuit is that of a velocity-modulated tube operating within an external resonant cavity. The tube is a reflex klystron, the name "reflex" being derived from the fact that a single set of grids performs the dual role of bunching and then catching the electron stream. The resonant cavity is connected to two of the electrodes, termed "resonator grids."

The resonator grids are physically separated from the cathode by an accelerator grid, which speeds up the electrons drawn from the cathode. The repeller electrode, on the opposite side of the resonator grids from the accelerator grid, is at a high negative potential so that it can repel the electron stream. Reference to figure 5-2 shows that the cathode of V102 is fixed at -1250 volts, while the repeller voltage can vary from -1250 volts to -1850 volts. Both of the resonator grids and the accelerator grid are of relatively coarse, open construction, so that the electrons can easily pass through them when electrical potentials are of the proper magnitude and polarity.

3-50. Assuming that the reflex klystron is oscillating, a periodically alternating r-f voltage then exists across the resonator grids, and a corresponding periodically reversing electric field is created. Thus, as the electrons from the cathode pass through the interaction space (resonator grids), some are speeded up by the electric field, while those electrons crossing during the negative alternation of the r-f cycle are slowed down. The electrons then travel toward the highly negative repeller electrode, some with less velocity than others. The high negative potential of the repeller causes the electrons to reverse their direction of travel and proceed back to the resonator grids. The faster electrons travel further toward the repeller and take a longer time to return to the interaction space. Originally having crossed this space earlier than the slower electrons, however, the faster electrons return to the space at the same time as the slower electrons. Thus both types of electrons, the slow and the fast, return in bunches to the resonator grids. These bunches tend to center at those electrons which initially passed through the interaction space when the r-f voltage across it was zero, and decreasing. If the bunched electrons arrive at the interaction space at a time when the r-f voltage between the resonator grids is a positive maximum, they will encounter the greatest opposition from the electric field, and will give up the maximum possible energy to the tank circuit. This energy replaces the tank circuit losses, and sustains oscillations. It is important to observe that the time of arrival of the bunched electrons at the interaction space is determined by the magnitude of the repeller voltage. In addition, the optimum time for sustaining oscillations involves an integral number of cycles plus three-quarters of a cycle (such as 1-3/4, 2-3/4, 3-3/4, etc.) between successive crossings of the interaction space by the same electrons. Thus, if the repeller voltage is maintained at that value which causes the bunched electrons to return to the interaction space in a time equal to 1-3/4, 2-3/4, etc. cycles, and the external cavity has been tuned to the corresponding frequency, the most favorable conditions for oscillation have been satisfied.

3-51. KLYSTRON CAVITY. The klystron cavity employed is in the form of a coaxial transmission line and consists of two cylinders, one inside the other. The klystron tube is inserted at one end of the cavity so that the outer cylinder makes contact with the first resonator grid, while the inner cylinder makes contact with the second resonator grid. The circuit is completed at the other end of the cavity by a movable non-contacting short-circuiting plunger. The position of this movable short circuit determines the resonant frequency of the cavity. If the short circuit is somewhat less than an odd multiple of a quarter-wavelength away from the resonator grids, the cavity presents a high impedance to the tube at the corresponding frequency, and is equivalent to an anti-resonant circuit. The movable short circuit is always less than an odd multiple of a quarter-wavelength away, because of the capacitive loading produced by the resonator grids. The loading permits the cavity to be physically shorter than would otherwise be required.

3-52. MODE SWITCHING. The frequency of oscillation is determined by the resonant frequency of the cavity and by the magnitude of the repeller voltage. For a given setting of the cavity, there is an optimum voltage which will cause the bunched electrons to return to the resonator grids at the proper time. (See figure 3-4.) The repeller voltage, therefore, cannot be kept constant over the frequency range of the oscillator. In order to make the oscillator function over its wide frequency range, a tracking arrangement is used to vary the d-c voltage on the repeller so that the repeller voltage is maintained at the optimum value for the maximum amplitude of oscillation. In the vicinity of 5,900 mc, however, the repeller voltage becomes excessively high, and it is convenient to change the repeller voltage to a new range. This can be done without changing the frequency of oscillation, at a particular cavity setting, by lowering the repeller voltage so that the tube operates in a higher mode; that is, the bunched electrons require a longer time in cycles to be returned to the resonator grids by the repeller electrode potential. By adjusting the repeller electrode voltage to the proper value, the bunched electrons still arrive at the resonator grids at that time which causes them to yield energy and sustain oscillations. The MSG-34 employs the 2-3/4 repeller mode over the frequency range from 4,200 to 5,900 mc, the 3-3/4 mode from 5,900 to 8,200 mc, and the 4-3/4 mode from 8,200 to 11,000 mc. The switching arrangement is explained in paragraph 3-53.

3-53. REPELLER VOLTAGE TRACKING CIRCUIT. The d-c voltage applied to the repeller is controlled by wire-wound potentiometer R101. The arm of this potentiometer is mechanically gauged with the movable short in the oscillator cavity so that the repeller voltage is maintained at the optimum point of oscillation. Repeller mode switch S101 is operated by a cam on the main tuning drive and changes the voltage applied to potentiometer R101 at 6,250 mc so that a different mode of voltage may be used at the repeller. Repeller mode switch S102 is operated by another cam which is on the same shaft as the cam actuating S101 and changes the voltage applied to potentiometer R101 at 8,250 mc so that a different mode of voltage may be used on the klystron repeller. The values of the resistors in the tracking circuit are selected to insure that the proper frequency-versus-voltage characteristic is obtained for the repeller electrode. Potentiometers R102, R103, R105, R106, R107, and R108 are screwdriver adjusted controls which set

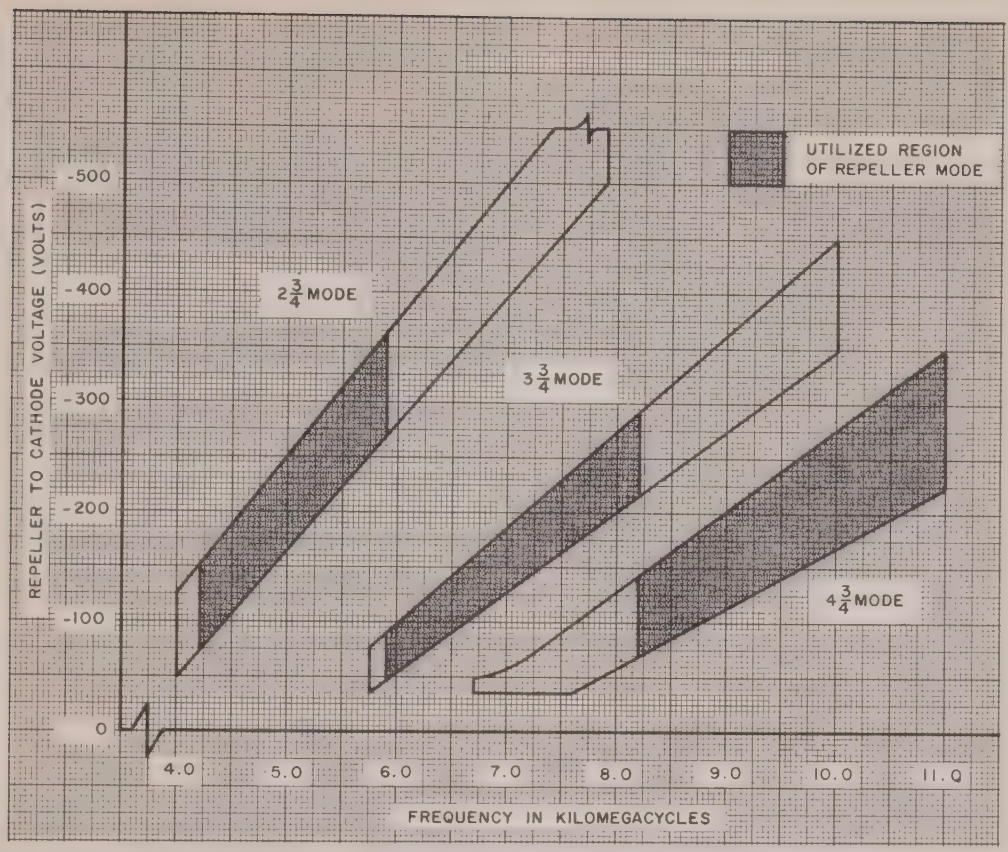


Figure 3-4. Typical Repeller Voltage Versus Frequency Characteristic Curve

the voltage applied to tracking potentiometer R101. The maximum excursion of input voltage across R101 varies from -1250 volts (beam supply) to -1850 volts (repeller supply). Since the cathode of V102 is fixed at -1250 volts the potential difference between the repeller electrode of the tube and the cathode can vary from 0 to -600 volts.

3-54. PROTECTIVE DIODE V101. Protective diode V101 (see figure 5-2) is connected between the cathode of the klystron oscillator and the repeller electrode and is employed to prevent the repeller from going positive with respect to the cathode, thereby preventing possible damage to the klystron.

3-55. Reference to figure 5-2 shows that the cathode of protective diode V101 is connected directly to the cathode of klystron V102, which is tied to -1250 volts. Since the plates of the diode are directly connected to the repeller electrode of the klystron, any disturbance serving to make these plates more positive than -1250 volts will cause V101 to conduct. Because the plate-to-cathode resistance of V101 is much smaller than the external load resistor (R111) when V101 is conducting, most of the voltage drop takes place across R111 and the potential on the plates of V101 remains at essentially the same voltage as its cathode, -1250 volts. Thus the repeller electrode of V102 consistently remains at a minimum absolute potential of -1250 volts despite any factor that might tend to drive the repeller more positive than the cathode.

3-56. FUNCTIONAL OPERATION OF THE MECHANICAL COMPONENTS. The electro-mechanical schematic diagram, figure 3-5, illustrates the ganging of the thermistor and attenuator probes. The tuning plunger does not mechanically contact the inner and outer conductors. Broadband effective "short-circuit" is achieved by making the choke approximately a 1/4-wavelength at mid-band, keeping the gap between the choke and inner and outer conductors to a practical minimum, and using teflon as a bearing surface. There are two required conditions for proper oscillation. The plunger must be at a predetermined position within the coaxial line and the repeller voltage must be at some proper value within a predetermined repeller mode. The plunger is driven by a cam which corrects for the non-linearity of plunger position with frequency. With a fixed cam the variations of tuning curve from klystron to klystron would not permit better than an approximately 5 percent frequency dial accuracy. Frequency dial accuracy, with tube changes, is improved to one percent by making the cam adjustable through five variable eccentric points. The second requirement for oscillation is obtained by mechanically ganging a tapped potentiometer to the

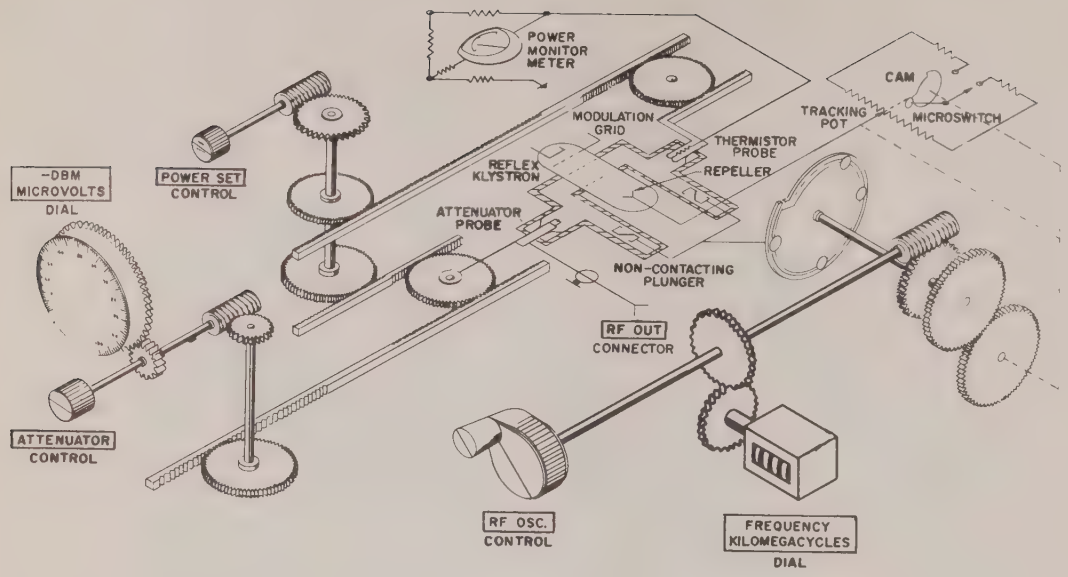


Figure 3-5. R-F Oscillator, Simplified Electromechanical Diagram

camshaft that automatically tracks and switches repeller modes. The cavity has two identical waveguide-beyond-cutoff outputs; the guide for the thermistor probe, which is one arm of a Wheatstone bridge, and that for the output attenuator. Adjustment of the POWER SET control moves both the thermistor and attenuator probes in a 1:1 ratio. The output attenuator probe position is independently controlled by the ATTENUATOR control. To calibrate the output attenuator, the Wheatstone bridge is balanced with the r-f oscillator off. With the oscillator on, the POWER SET control is adjusted so that the power monitor meter reads POWER SET. Actual power output can now be read directly from the -DBM MICROVOLTS dial. If the r-f oscillator is changed to any other frequency, the same calibrated r-f output power is maintained by simply readjusting the POWER SET control so that the power monitor meter once again reads POWER SET. Manual adjustment of the frequency is made with the RF OSC control.

3-57. POWER MONITORING CIRCUIT. The r-f power monitoring circuit consists of a Wheatstone type bridge (see figure 5-2) that measures power by the use of a variable resistance element (thermistor) in a bridge circuit. A thermistor has a negative coefficient of resistance: i.e., as the temperature increases, its resistance decreases and vice versa. Changes of thermistor temperature, and hence resistance, are governed by three factors; by thermal changes in its environment, by the current flowing through it, and by the r-f power it absorbs. By controlling two factors, current and ambient temperature, the bridge will determine the r-f power by measuring the change in thermistor resistance caused by the applied r-f power.

3-58. Two types of thermistors are used in the signal generator: the bead type (RT101) and the disc type (RT102 and RT103). The bead thermistor, used for power measurement, has a small mass and is affected by all the changes mentioned above. The disc thermistor, used in compensating networks, has a large mass and its resistance is relatively insensitive to the current flowing through it. It is dependent primarily on the ambient temperature.

3-59. The basic bridge circuit, consisting of resistors R115, R116, R119, and bead thermistor RT101 (RT101 is a part of the thermistor probe assembly located in the waveguide-beyond-cutoff tube) is balanced (zero set) by adjusting ZERO SET control R51. After the power monitor meter has been zero set, any r-f power fed into the waveguide-beyond-cutoff tube will be absorbed by the bead thermistor, thus unbalancing the bridge. The bridge is so designed that, for a given frequency, the bead thermistor probe must be inserted into the waveguide a definite amount so that one milliwatt of r-f power will be indicated by the POWER SET mark on the power monitor meter. Movement of the bead thermistor is controlled by the POWER SET control. The function of disc thermistor RT103 is to compensate for the variation in meter sensitivity due to changes in ambient temperature. RT102 is employed to correct for any d-c unbalance due to ambient temperature changes. The disc thermistors are located on

a thermistor mount which is clamped to the thermistor waveguide tube.

3–60. DETAILED CIRCUIT ANALYSIS, POWER SUPPLIES.

3-61. Paragraphs 3-62 through 3-67 contain a detailed circuit analysis of the power supplies employed in the MSG-34.

3-62. BEAM POWER SUPPLY. When POWER switch S1 is closed, 115 volts a-c is applied to all circuits except the beam power supply. (See figures 3-6 and 5-2). In order to protect the klystron tube, thermal time delay relay K1 is energized through the normally closed contacts (4 and 2) of hold relay K2. After a delay of 60 seconds, contacts 3 and 8 of relay K1 close. D-c from the +210 volt supply passes through the coil of hold relay K2, the normally open circuit contacts (3 and 4) close and apply a-c to the beam supply and simultaneously deenergize delay relay K1.

3-63. The function of the beam supply is to supply the necessary voltages and currents to the interaction grids of V102, so that they can be maintained at a positive potential with respect to the cathode. Since the interaction grids contact the klystron oscillator barrel assembly, it is safer to ground the positive side of the power supply. The beam supply consists of voltage doubler V1 and V2, series regulator V3, amplifier V4, and voltage regulators V5 and V6. The screen of V3 has B+ applied to it from the +210 volt supply. Control grid voltage for the d-c amplifier section of V4 is obtained from the power supply through -1250 V Adj. control R8.

3-64. REPELLER POWER SUPPLY. The function of the repeller power supply is to furnish a repeller voltage which is always negative with respect to the klystron cathode. In order to make the repeller voltage negative with respect to the cathode, the positive side of the repeller supply is tied to the negative output of the beam supply. Thus, though the total output variation from the circuit is 600 volts, the absolute potential varies from -1250 volts to -1850 volts. Screwdriver adjustment potentiometer R31 is employed to set the -1850 volt output which supplies the repeller tracking circuit. A

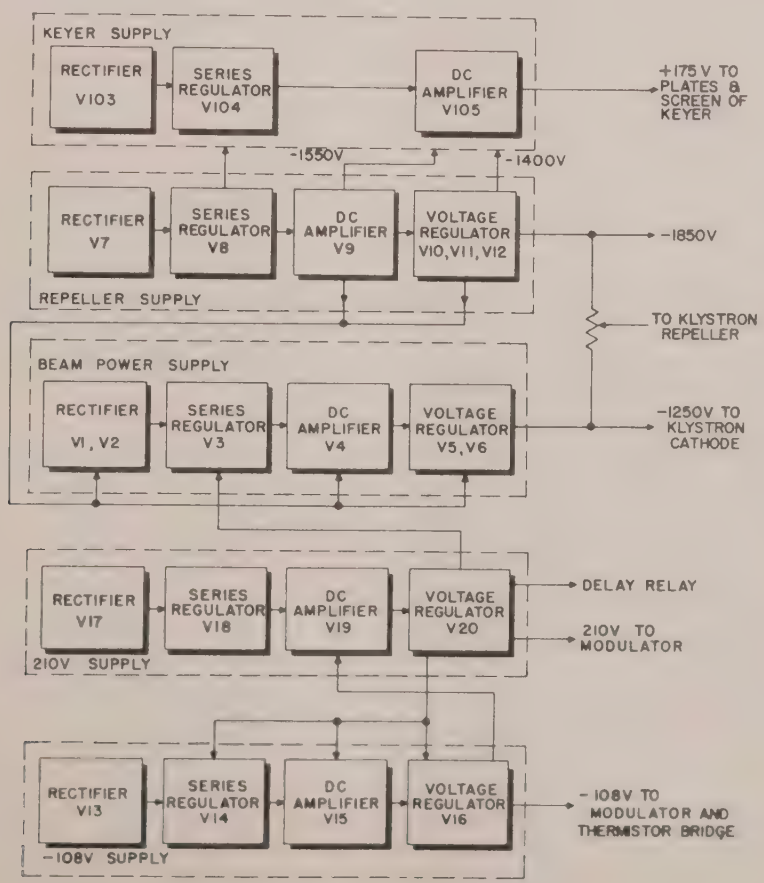


Figure 3-6. Power Supplies, Functional Block Diagram

fixed -1400 volts is available at the anode of V12, and is used as a common reference voltage for the cathodes of the keyer power supply and keyer circuit. The -1550 volts at the cathode of V12 supplies negative bias and reference voltage for the keyer supply and keyer circuit with respect to the -1400 volt line. The repeller supply consists of rectifier V7, series regulator V8, amplifier V9, and voltage regulators V10, V11, and V12.

3-65. KEYER POWER SUPPLY. The keyer power supply (see figures 3-6 and 5-2) furnishes B+ voltage for the plates and screens of the keying circuit, and sets the klystron grid bias when the signal generator is set for cw operation. The keyer supply is capable of supplying 150 to 170 volts. The voltage setting depends upon the klystron bias needed to allow 20 to 25 ma of beam current to flow in the klystron oscillator. Beam Current Adj control R127 is used to set the klystron grid bias in cw operation. The keyer power supply consists of a full-wave rectifier, V103, series regulator V104, and combination d-c amplifier and voltage control V105. The negative side of this supply is referenced to the -1400 volt line and is taken from a fixed reference point in the repeller supply.

3-66. MODULATOR POWER SUPPLY. The modulator power supply furnishes a constant -108 volts to balance the bridge circuit, and also supplies bias voltage for the internal modulator. (See figures 3-6 and 5-2.) Full-wave rectification is accomplished by V13. V14 serves as a d-c amplifier and voltage control tube. V16 provides a reference voltage for the regulator circuit.

3-67. The +210 volt supply, which is part of the modulator supply, furnishes B+ for the modulator circuit. It also supplies the power to energize hold relay K2 through delay relay K1. Rectification is accomplished by V17, while V19 serves as a d-c amplifier and voltage control tube. Reference voltage is supplied by V20. +210 V Adj control R63 permits the voltage output of the power supply to be set to the required level.

SECTION IV
MAINTENANCE

4—1. GENERAL.

4-2. This section contains maintenance and alignment procedures for the Model MSG-34 Microwave Signal Generator. Included are a list of test equipment required, minimum performance standards for localizing the source of system malfunction to an individual subassembly or component, and the alignment procedures required to restore the MSG-34 to its original operating condition after the necessary repairs have been effected.

4—3. TEST EQUIPMENT REQUIRED.

4-4. The test equipment required for the maintenance and alignment of the MSG-34 are listed in table 4-1.

4—5. PRELIMINARY INSPECTION.

4-6. Preliminary inspection consists of a series of visual checks performed on the Model MSG-34 while it is in an unenergized state in an effort to correct conditions which might eventually cause failure. In general these failures will be caused by the overheating of electrical components, the accumulation of dust, dirt, and/or other foreign matter on moving parts, and loose connectors and hardware.

4-7. REMOVAL OF MODEL MSG-34 FROM DUST COVER. To remove the MSG-34 from its dust cover, proceed as indicated in the following steps:

WARNING

OPERATION OF THE MSG-34 INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. BE SURE TO REMOVE OPERATING POWER FROM THE UNIT BY DISCONNECTING THE 10-FOOT ELECTRICAL POWER CABLE ASSEMBLY FROM POWER INPUT 115V 50-60 CPS RECEPTACLE BEFORE ATTEMPTING TO REMOVE THE EQUIPMENT FROM ITS DUST COVER.

a. Turn each of the four captive-lock fasteners located at the rear of the dust cover one quarter turn counterclockwise with a screwdriver.

b. With two men working on the MSG-34 (one on each side of the equipment), grasp the two basic unit front panel handles and carefully slide the MSG-34 from its dust cover.

4-8. REMOVAL OF R-F HEAD FROM BASIC UNIT. To remove the r-f head from the basic unit, proceed as outlined in the following steps.

a. Disconnect P1 from J1.

b. Disconnect P107 from J107.

c. Disconnect P103 from J103.

d. Remove the four screws that secure the r-f head to the basic unit frame.

e. Grasp the r-f head and carefully slide it forward and out of the basic unit.

4-9. Inspect the MSG-34 as outlined in table 4-2.

4—10. MINIMUM PERFORMANCE STANDARDS.

4-11. The purpose of the minimum performance standards listed in table 4-3 is to determine if the MSG-34 is operating in compliance with the specifications listed in Section I. Should the MSG-34 fail to meet any of the specifications, the trouble may be determined and corrected through the use of the trouble-shooting table (table 4-4) referred to in the minimum performance standards. (See figures 4-14, 4-15, 4-16 and 4-17.)

4—12. SYSTEM TROUBLESHOOTING.

4-13. The procedures for localizing the source of system malfunctions are described in paragraphs 4-14 through 4-16.

4-14. TROUBLESHOOTING POWER SUPPLIES. Improper operation of the MSG-34 may be caused by a malfunction within the power supplies located in the basic unit and the r-f head. Localization of the malfunction to an individual circuit may be accomplished through the voltage and resistance measure-

TABLE 4-1. TEST EQUIPMENT REQUIRED

Equipment, Model, and Manufacturer	Application
Simpson Model 260 Multimeter	Checking voltages and resistances
John Fluke Model 801 Differential Voltmeter	Checking and setting beam and repeller power supply voltages
John Fluke Model 80B5 Volt Box	Checking and setting beam and repeller power supply voltages
Hewlett-Packard Model 430C Microwave Power Meter	Checking generator power output
Hewlett-Packard Model 477B Thermistor Mount	Checking generator power output
Polarad Model K-200 Microwave Tube Tester	Checking reflex klystron
Polarad Model MK-1 Klystron Mode Alignment Modulator	Tracking oscillator repeller voltage
Tektronix Model 531 Oscilloscope	Tracking oscillator repeller voltage
Sage Model 1071 Crystal Detector	Tracking oscillator repeller voltage
FXR Models H410, C410, and X410 Frequency Meters	Tracking oscillator repeller voltage
FXR Models H601B, C601B, and X601B Waveguide-to-Coax Adapters	Tracking oscillator repeller voltage, determining output VSWR, and checking equipment's operation
FXR Models H101A, C101A, and X101A Slotted Sections	Determining Output VSWR
Hewlett-Packard Model 415B Standing Wave Indicator	Determining output VSWR
Hewlett-Packard Model 523DR Electronic Counter	Setting minimum pulse repetition rate
Polarad Model MP-1A Multipulse Generator	Checking externally pulse-modulated operation
Hewlett Packard Model 202C Oscillator	Determining externally frequency-modulation operation
Polarad Model SA-84WA Spectrum Analyzer	Determining externally frequency-modulation operation

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE

What to Inspect	Defects To Look For	Remedies	Precautions
Cable assemblies	Kinks, cuts, deterioration, and fraying of insulation	Replace defective cable assembly	
	Loose connectors	Resolder connectors or replace cable assembly	
	Dirt, oil, grease and corrosion	Clean with a cloth moistened with cleaning solvent	
Harnessed cables	Loose connectors	Resolder connectors	
	Deteriorated and/or frayed leads	Replace lead and relace cable	
	Defective or poor lacing	Relace cable	
Knobs, screws, connectors, and handles	Looseness	Tighten	Tighten carefully. Screws tightened beyond pressure for which they were designed may be damaged or broken
Front panel switches	Inability to change position	Replace and rewire switch	
	Looseness	Tighten mounting hardware	
	Bent or broken contacts	Straighten contacts or replace and rewire switch	
Fuses	Dirty fuse holders	Clean with a cloth	
Frame assemblies and basic unit subassemblies	Dirt and rust	Remove with brush or low-pressure air	
	Oil and grease	Remove with a cloth moistened with cleaning solvent	
Mounting screws and clamps	Looseness	Tighten	Do NOT touch slotted shafts of variable resistors
Wiring	Loose Wires	Resolder, recable, and reclamp	
	Frayed, worn, or missing insulation	Replace wire	

(Cont'd)

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (Cont'd)

What to Inspect	Defects To Look For	Remedies	Precautions
Terminal board assemblies	Loose mounting	Tighten mounting screws	
Solder joints	Corroded joints	Clean and resolder	
Resistors	Cracks, chips, discoloration, blistering, and other signs of overheating	Replace resistor	Overheating components are a sign of equipment malfunction. Refer to proper troubleshooting table to localize malfunction.
Capacitors	Leaks, bulges, and other signs of deterioration	Replace capacitor	See above
Front panel meter	Bent pointer	Replace meter	
	Cracked or broken meter	Replace meter	
Vacuum tubes (except for reflex klystron)	Poor seating	Press tubes firmly into sockets	Never work on tubes immediately after shutting off power. Do not jiggle or partially remove tubes from sockets. Such movements tend to weaken tube pins and spread socket connectors. DO NOT CHECK REFLEX KLYSTRON.
Tube shields (except for reflex klystron protective shield)	Poor seating	Press into position	
	Missing shields	Replace	
Tube sockets	Cracked or chipped sockets	Replace and rewire	
	Looseness	Tighten mounting screws	
FREQUENCY KILOMEGACYCLES dial window	Cracked or broken	Replace (A temporary repair may be effected with transparent tape)	

(Cont'd)

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (Cont'd)

What To Inspect	Defects To Look For	Remedies	Precautions
-DBM MICRO-VOLTS dial window	Cracked or broken	See above	
Precision mechanical drive system	Catching or jamming when RF OSC control is rotated	Remove dust, dirt, and any foreign matter	**CAUTION** DO NOT MOVE THE PRECISION MECHANICAL DRIVE SYSTEM BY ANY MEANS OTHER THAN THE RF OSC CONTROL. DO NOT INTERFERE WITH THE OPERATION OF THE GEARS WHILE THE RF OSC CONTROL IS BEING ROTATED. NEVER USE FORCE.
	Catching or jamming when either POWER set or ATTENUATOR control is rotated	See above	
	Broken gears	Replace	

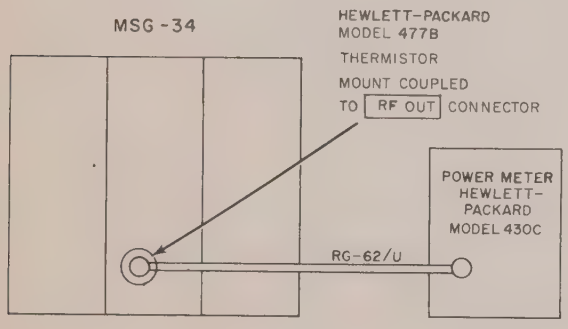


Figure 4-1. Test Setup to Determine Power Set Operation

ments supplied in tables 5-1 and 5-2, the component location diagrams supplied in figures 4-14 and 4-15, and the overall schematic diagram of the MSG-34 less modulator assembly shown in figure 5-2.

Note

When making voltage and resistance measurements, make certain that all connectors are firmly secured to their mating receptacles.

4-15. If the power supplies are found to be operating properly, the malfunction lies within either the modulator unit or turning unit. Refer to paragraph 4-16.

4-16. TROUBLESHOOTING MODULATOR UNIT AND RF HEAD. If the results of paragraph 4-14 indicate that the system malfunction lies within the modulator unit and r-f head, proceed as indicated in table 4-4 to localize the trouble. Refer also to schematic diagram of the modulator shown in figure 5-1, voltage and resistance measurements in table 5-3, and the component location diagrams supplied in figures 4-16, and 4-17. Voltage and resistance measurements for the r-f and keyer are given in table 5-2.

4—17. DISASSEMBLY AND REASSEMBLY INSTRUCTIONS.

4-18. Disassembly and reassembly instructions for the MSG-34 are given in paragraphs 4-19 through 4-25.

4-19. REMOVAL OF THERMISTOR PROBE ASSEMBLY. To remove the thermistor probe assembly, proceed as outlined in the following steps: (see figure 4-18)

a. Disconnect P102, (1, figure 4-18) from J102.

b. Rotate the POWER SET control fully clockwise.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
1	To evaluate operating power conditions.	Connect power cable (and power cable adapter, if necessary) between POWER INPUT 115 V 50-60 CPS receptacle and power source outlet. Set POWER-ON-OFF switch to POWER ON.	POWER indicator lights upon application of operating power.	Check DS2, F1, F2, power cable, and POWER-ON OFF switch.
			KLYSTRON indicator lights approximately 60 seconds after application of operating power.	Check DS1, K1, and K2.
2	To evaluate ZERO SET operation.	Set MODULATION SELECTOR switch to ZERO SET. Adjust ZERO SET control to obtain power monitor meter pointer deflection of ZERO.	Power monitor meter pointer deflects to an indication of ZERO.	See table 4-4, step 1.
3	To evaluate POWER SET operation.	Connect equipment as shown in Figure 4-1. Program MSG-34 for CW operation. (Refer to paragraph 2-10.) a. Rotate RFOSC control to obtain indication of 4.20 on FREQUENCY KILOMEGACYCLES dial. b. Zero-set MSG-34 as outlined in step 2. c. Adjust POWER SET control to obtain power monitor meter pointer deflection of POWER SET. d. Adjust ATTENUATOR control to obtain 0 dbm indication on - DBM MICROVOLTS dial. e. Note deflection on the power meter. f. Repeat procedure for FREQUENCY KILOMEGACYCLES dial indications of 5.5, 6.5, 8.0, 8.5, and 11.00.	Power monitor meter pointer deflects to POWER SET.	See table 4-4, step 2.
			Power level indicated by the power meter is 0 dbm ± 2 db (between 0.631 and 1.58 milliwatts) at each Frequency.	See table 4-4, step 2.
4	To evaluate CW operation.	Connect equipment as shown in Figure 4-2. Program MSG-34 for CW operation. (Refer to paragraph 2-11.) a. Rotate RFOSC control to	Frequency indicated on absorption type frequency meter is ± 1% of that indicated on FREQUENCY KILOMEGACYCLES dial.	See table 4-4, step 3.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
4	To evaluate CW operation.	set FREQUENCY KILOMEGACYCLES dial to 4.20. b. Zero-set and power-set MSG-34 as outlined in steps 2 and 3, respectively. c. Adjust frequency meter to obtain a dip of the power meter pointer deflection. d. Note Frequency meter indication. e. Repeat procedure for FREQUENCY KILOMEGACYCLES dial indications of 5.50, 6.50, 8.00, 8.50, 11.00.		
5	To evaluate INT SQWV operation.	Connect equipment as shown in Figure 4-3. Program MSG-34 for INT SQWV operation. (Refer to paragraph 2-12.) a. Rotate RFOSC control to obtain FREQUENCY MEGACYCLES dial indication near low end of band. b. Zero-set and power-set MSG-34 as outlined in steps 2 and 3, respectively. c. Note oscilloscope displays for following settings of RATE CYCLES/SECOND control and RATE CYCLES/SECOND multiplier switch: RATE CYCLES/SECOND Control / RATE CYCLES SECOND Multiplier Switch 10 / X1 100 / X1 10 / X10 100 / X10 10 / X100 100 / X100	Detected square wave frequency variable from 10 to 10,000 cps. Asymmetry does not exceed ± 10%.	See table 4-4, step 4. See paragraph 4-29. See paragraph 4-30.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
6	To evaluate INT PULSE operation.	Connect equipment as shown in Figure 4-4. Program MSG-34 for INT PULSE operation. (Refer to paragraph 2-13.) a. Rotate DELAY MICROSECONDS control fully counterclockwise. Set DELAY MICROSECONDS multiplier switch to X1. b. Zero-set and power-set MSG-34 as outlined in steps 2 and 3, respectively. c. Note oscilloscope display for following settings of PULSE WIDTH MICROSECONDS control, RATE CYCLES/SECOND control, and RATE CYCLES/SECOND multiplier switch:	Pulse width variable from 0.2 to 10 microseconds. Pulse repetition rate variable from 10 to 10,000 pps.	See table 4-4, step 7, and paragraph 4-33. See paragraph 4-29.

Pulse Width Microseconds Control	Rate Cycles/Second Control	Rate Cycles/Second Switch
0.2	10	X1
0.2	100	X1
0.2	10	X10
0.2	100	X10
0.2	10	X100
0.2	100	X100

Pulse Width Microseconds Control	Rate Cycles/Second Control	Rate Cycles/Second Multiplier Switch
10	10	X1
10	100	X1
10	10	X10
10	100	X10
10	10	X100
10	100	X100

7	To evaluate characteristics of undelayed sync output pulse.	Connect equipment as shown in Figure 4-5. Program MSG-34 for INT PULSE operation. (Refer to paragraph 2-13.)	Pulse obtained at UNDELAYED SYNC OUT connector is positive 15 volts peak (minimum), and has a rise	See table 4-4, step 5.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

<table>
<tr><th>Step</th><th>Purpose</th><th>Procedure</th><th>Normal Indication</th><th>If Indication Is Abnormal</th></tr>
<tr><td rowspan="2">7</td><td rowspan="2">To evaluate characteristics of undelayed sync output pulse.</td><td rowspan="2">a. Zero-set and power-set MSG-34 as outlined in steps 2 and 3 respectively.

b. Note oscilloscope display for following settings of RATE CYCLES/SECOND control and RATE CYCLES/SECOND multiplier switch:

RATE CYCLES/SECOND Control / RATE CYCLES/SECOND Multiplier Switch
10 / X1
100 / X1
10 / X10
100 / X10
10 / X100
100 / X100</td><td>time of less than 0.1 microsecond.</td><td></td></tr>
<tr><td>Pulse repetition rate is variable from 10 to 10,000 pps.</td><td>See paragraph 4-29.</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">To evaluate characteristics of delayed sync output pulse.</td><td rowspan="2">Connect equipment as shown in Figure 4-6. Program MSG-34 for INT PULSE operation. (Refer to paragraph 2-13.)

a. Zero-set and power-set MSG-34 as outlined in steps 2 and 3, respectively.

b. Set RATE CYCLES/SECOND control to 10 and RATE CYCLES/SECOND switch to X100.

c. Note oscilloscope display for following settings of DELAY MICROSECONDS control and DELAY MICROSECONDS multiplier switch:

DELAY MICROSECONDS Control / DELAY MICROSECONDS Multiplier Switch
2 / X1
20 / X1
2 / X10
20 / X10
2 / X100
20 / X100</td><td>Pulse obtained at DELAYED SYNC OUT connector is positive, 15 volts peak (minimum), and has a rise time of less than 0.1 microsecond.</td><td>See table 4-4, step 6.</td></tr>
<tr><td>Delay variable from 2 to 2000 microseconds.</td><td>See paragraphs 4-31 and 4-32.</td></tr>
</table>

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indications	If Indication Is Abnormal
9	To evaluate externally synchronized pulse-modulated operation.	Connect equipment as shown in Figure 4-7. Program MSG-34 for externally synchronized pulse-modulated operation. (Refer to paragraph 2-14.) a. Zero-set and power-set MSG-34 as outlined in steps 2 and 3 respectively. b. Adjust output level of pulse generator to 40 volts peak. c. Adjust DELAY MICROSECONDS control R234 and DELAY MICROSECONDS multiplier switch S204 for minimum delay. d. Note oscilloscope display for following PULSE WIDTH MICROSECONDS control and pulse generator repetition rate control settings. Pulse Width Microseconds Control / Pulse Generator Repetition Rate Control 0.3 / 10 10 / 10 0.3 / 100 10 / 100 0.3 / 1000 10 / 1000 0.3 / 10,000 10 / 10,000	Pulse width of externally - synchronized output pulse adjustable from 0.3 to 10 microseconds. Repetition rate determined by that of external pulse generator.	See table 4-4, step 11.
10	To evaluate FM operation.	Connect equipment as shown in Figure 4-8. Program MSG-34 for internally synchronized FM operation. (Refer to paragraph 2-16.) a. Zero-set and power-set MSG-34 as outlined in steps 2 and 3, respectively. b. Rotate FM AMP control fully clockwise. c. Set RATE CYCLES/SECOND control to 10, and RATE CYCLES/SECOND multi-	Modulated output pulse has frequency excursion of at least ± 2.5 MC. (Refer to Figure 4-9.) Repetition rate adjustable from 10 to 10,000 pps.	See table 4-4, step 8. See paragraph 4-29.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
10	To evaluate FM operation.	plier switch to X1. d. Note oscilloscope display (Refer to Figure 4-9.) e. Adjust frequency meter to obtain a dip at the trailing edge of display. Note frequency meter indication. f. Adjust frequency meter to obtain dip at leading edge of display. Note frequency meter indication. g. Repeat procedure for following settings of RATE CYCLES/SECOND control and RATE CYCLES/ SECOND multiplier switch. RATE CYCLES/ SECOND Control — RATE CYLCES/ SECOND Multiplier Switch 10 — X1 100 — X1 10 — X10 100 — X10 10 — X100 100 — X100		
11	To evaluate EXT FM operation.	Connect equipment as shown in Figure 4-12. Program MSG-34 for EXT FM operation. (Refer to paragraph 2-17.) a. Zero-set and power-set MSG-34 as outlined in steps 2 and 3 respectively. b. Adjust oscillator for a 50 volts peak output. Set oscillator repetition frequency to 1000 cps. c. Repeat procedure for the following repetition frequencies. 10cps, 100 cps, 10 kc, and 100 kc.	Modulated output pulse has frequency excursion of at least ± 2.5 MC.	See table 4-4, step 12.
12	To evaluate EXT MOD operation.	Connect equipment as shown in Figure 4-10. Program MSG-34 for EXT MOD operation. (Refer	Output pulses obtained dependent µpon applied modulating pulses.	See table 4-4, step 10.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
12	To evaluate EXT MOD operation.	to paragraph 2-15.) a. Zero-set and power-set MSG-34 as outlined in steps 2 and 3, respectively. b. Adjust output level of pulse generator to 40 volts peak. c. Note oscilloscope display for following settings of pulse generator pulse width and repetition rate controls: Pulse Width Control — Repetition Rate Control 0.2 microseconds — 10 pps 0.2 microseconds — 10,000 pps 100 microseconds — 10 pps 100 microseconds — 7,500 pps	Repetition rate adjustable from 10 to 10,000 pps. Pulse width adjustable from 0.2 to 100 microseconds.	
13	To determine output VSWR.	Connect equipment as shown in Figure 4-11. Wiht POWER-ON-OFF switch set to OFF, determine output VSWR at various frequencies throughout the band.	Output VSWR less than 2.5:1.	Clean or replace RF OUT connector J101.
14	To determine output impedance.	With POWER-ON-OFF-switch set to OFF, measure resistance between center conductor of RF OUT connector and chassis ground in the ohmmeter.	Ohmmeter indicates 50 ± 5 ohms.	See table 4-4, step 2c and paragraph 4-23.

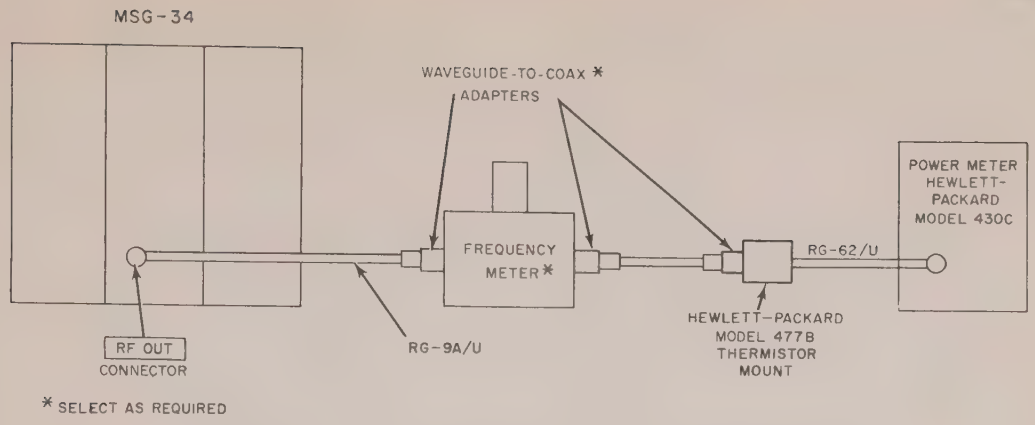


Figure 4-2. Test Setup to Determine CW Operation

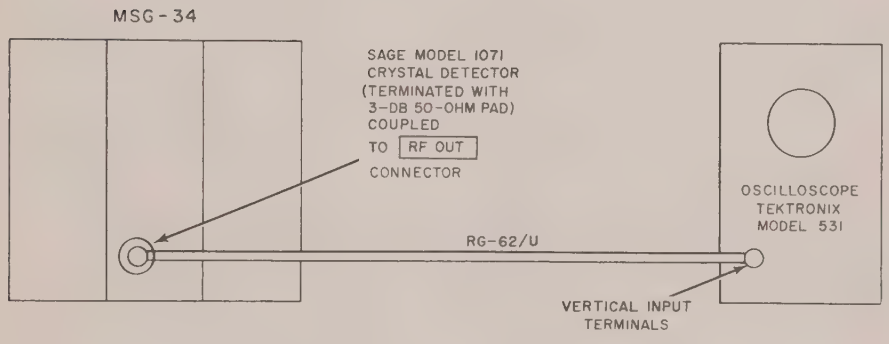


Figure 4-3. Test Setup to Determine INT SQ WV Operation

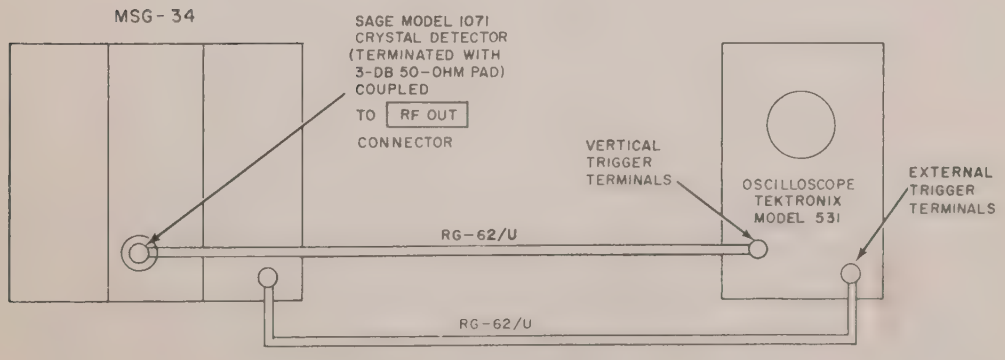


Figure 4-4. Test Setup to Determine INT PULSE Operation

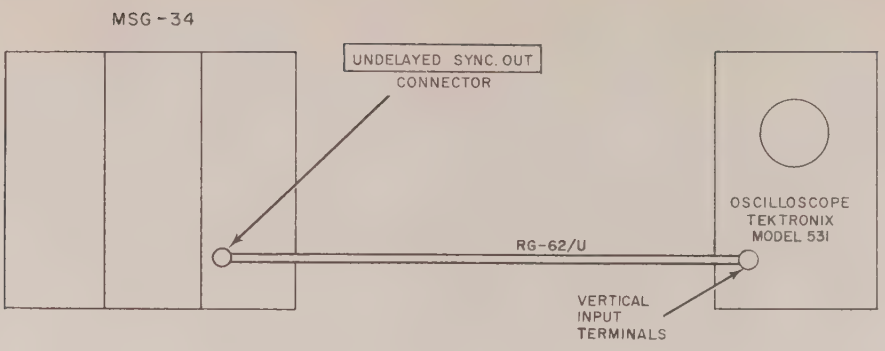


Figure 4-5. Test Setup to Determine Characteristics of Undelayed Sync Output Pulses

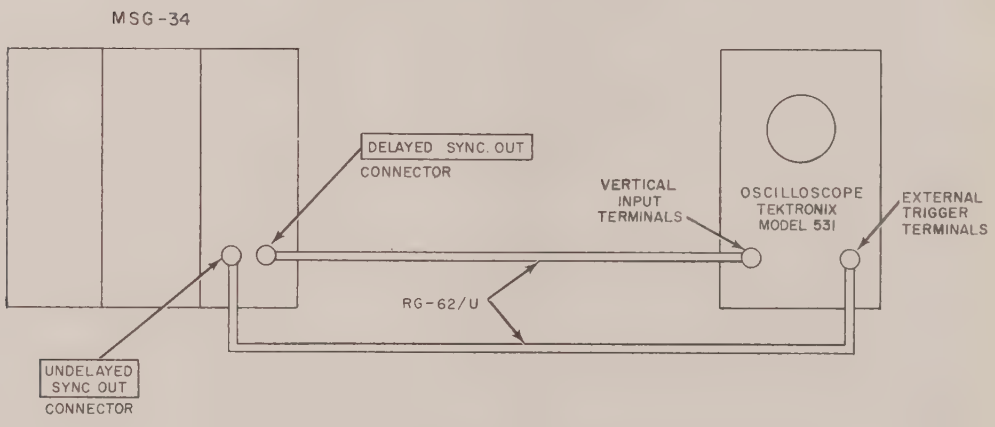


Figure 4-6. Test Setup to Determine Characteristics of Delayed Sync Output Pulses

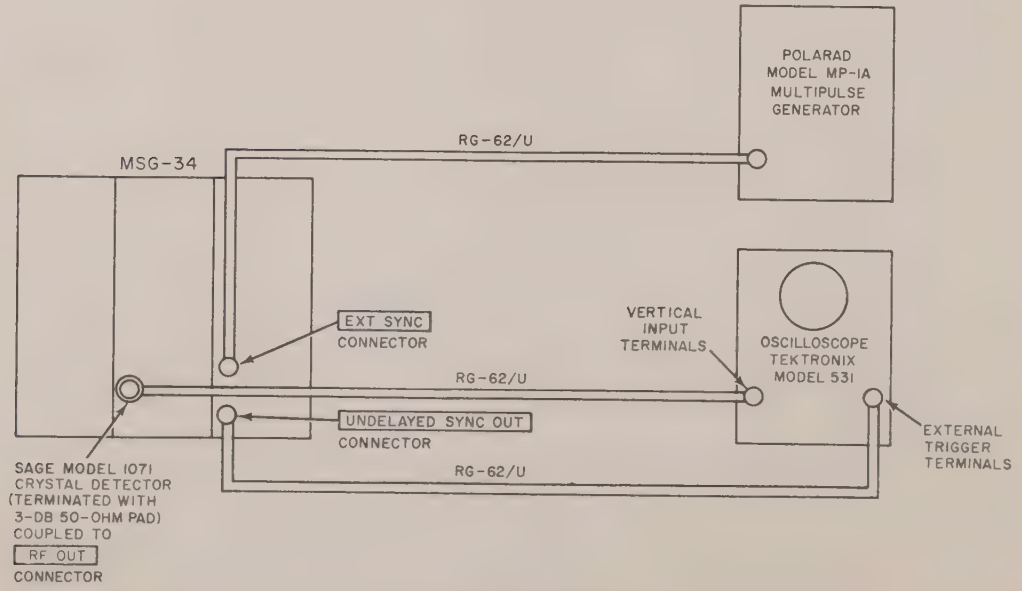


Figure 4-7. Test Setup to Determine Externally Synchronized Pulse Modulated Operation

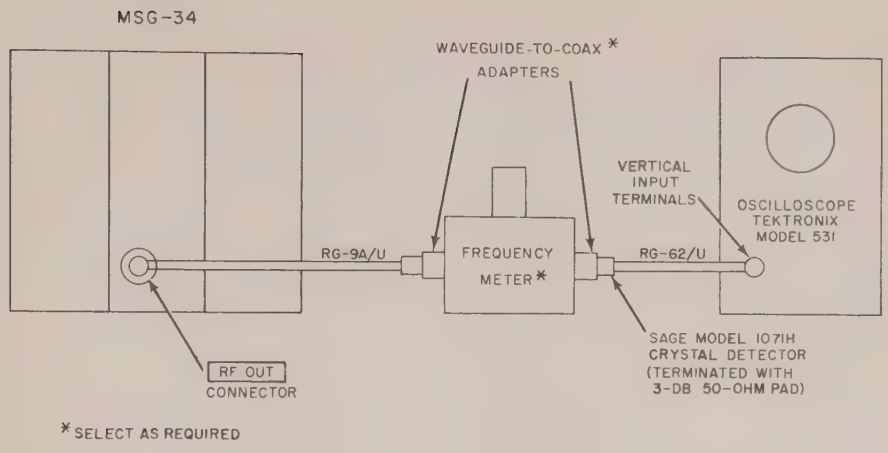
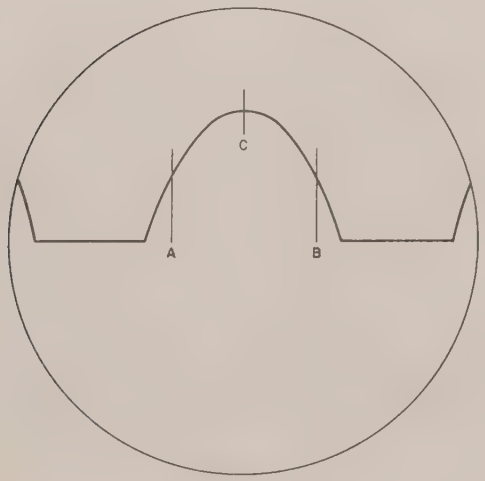


Figure 4-8. Test Setup to Determine FM Operation



Tune frequency meter to position dip at point A. Note frequency meter indication. Repeat for points B and C.

Frequency difference between A and C and between points B and C should each be equal or greater than 2.5 Mc

Figure 4-9. Typical Oscilloscope Display of Internally Synchronized Frequency-Modulation Output

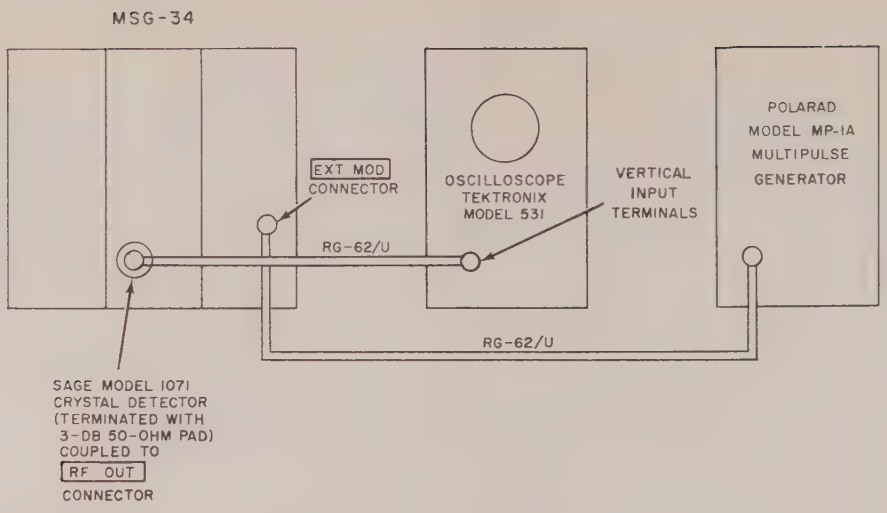


Figure 4-10. Test Setup to Determine EXT MOD Operation

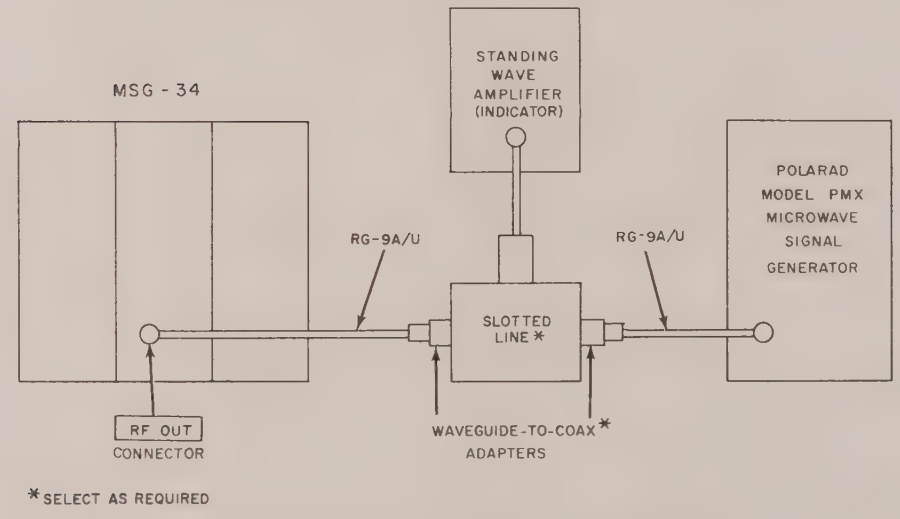


Figure 4-11. Test Setup to Determine Output VSWR

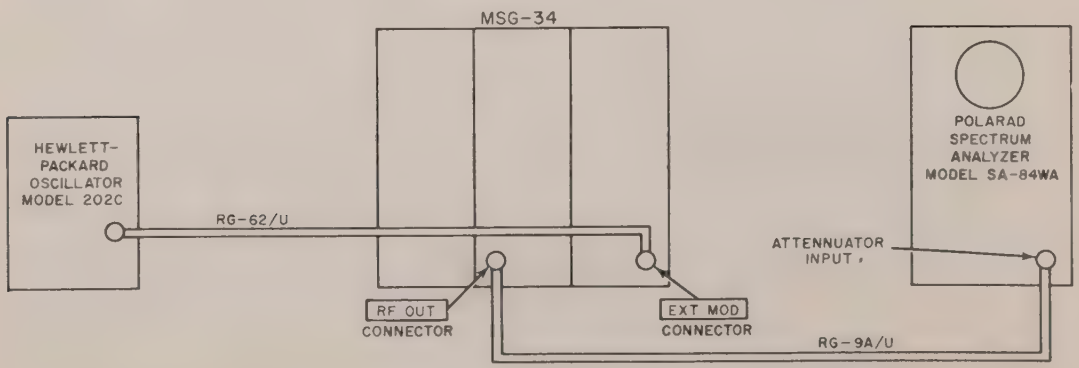


Figure 4-12. Test Setup to Determine External Frequency-Modulation Output

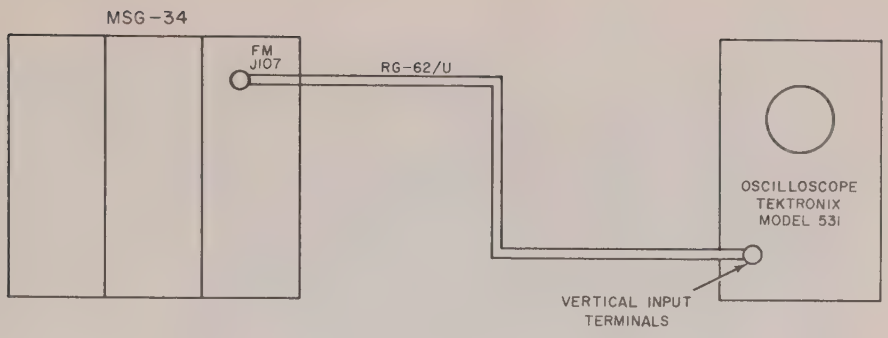


Figure 4-13. Test Setup to Determine Sawtooth Modulating Signal Output

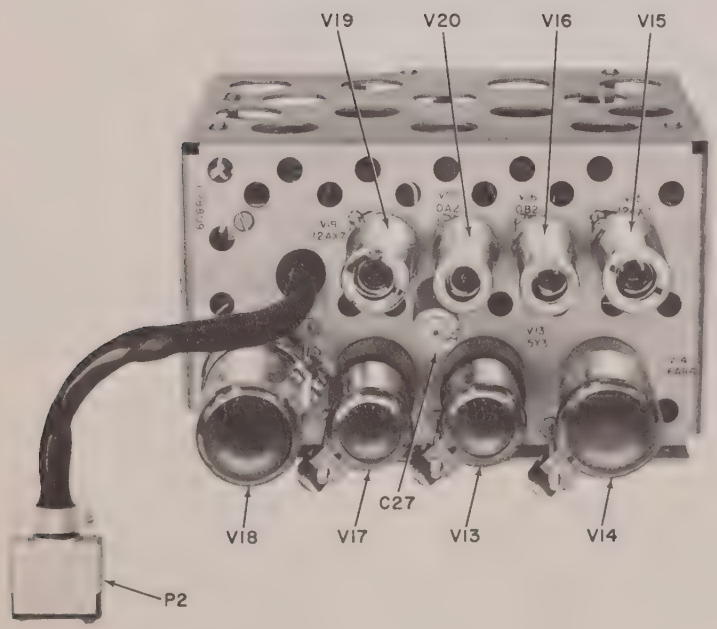


Figure 4-14. Modulator Power Supply, Top View

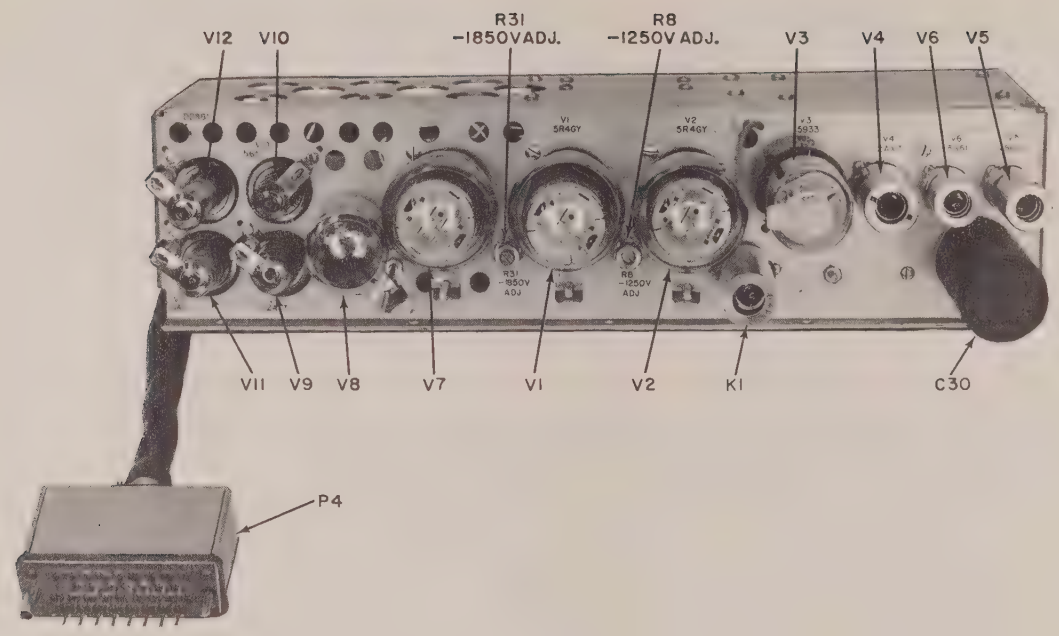


Figure 4-15. Repeller and Beam Chassis, Top View

c. Loosen the two setscrews (2, figure 4-18) which secure the thermistor probe assembly (3, figure 4-18) to the thermistor probe collar (4, figure 4-18).

d. Carefully slide the thermistor probe assembly from the thermistor probe barrel (5, figure 4-18) of the klystron cavity.

4-20. REPLACEMENT OF THERMISTOR PROBE ASSEMBLY. To replace the thermistor probe assembly, proceed as outlined in the following steps:

a. Insert the thermistor probe collar (4, figure 4-18) into the thermistor yoke (6, figure 4-18) by gently pressing them together.

b. Rotate the POWER SET control fully clockwise.

c. Insert the thermistor probe assembly (3, figure 4-18) through the thermistor probe collar and into the thermistor probe barrel (5, figure 4-18).

CAUTION

ADVANCING THE THERMISTOR PROBE TOO DEEPLY INTO THE KLYSTRON CAVITY WILL DAMAGE THE CAVITY.

d. Carefully advance the thermistor probe assembly until the probe tip just touches the hat located within the thermistor probe barrel.

e. Back off the thermistor probe assembly 1/32 inch.

f. Tighten the two setscrews (2, figure 4-18), securing the thermistor probe assembly to the thermistor probe yoke.

g. Connect P102 (1, figure 4-18) to J102.

h. Calibrate the r-f power output of the MSG-34 as outlined in paragraph 4-39.

4-21. REMOVAL OF THERMISTOR COMPENSATOR ASSEMBLY. To remove the thermistor compensator assembly, proceed as outlined in the following steps:

a. Remove the thermistor probe assembly as outlined in paragraph 4-19.

b. Loosen the two fillister-head screws (7, figure 4-18) which secure the thermistor compensator assembly (8, figure 4-18) to the thermistor probe barrel (5, figure 4-18).

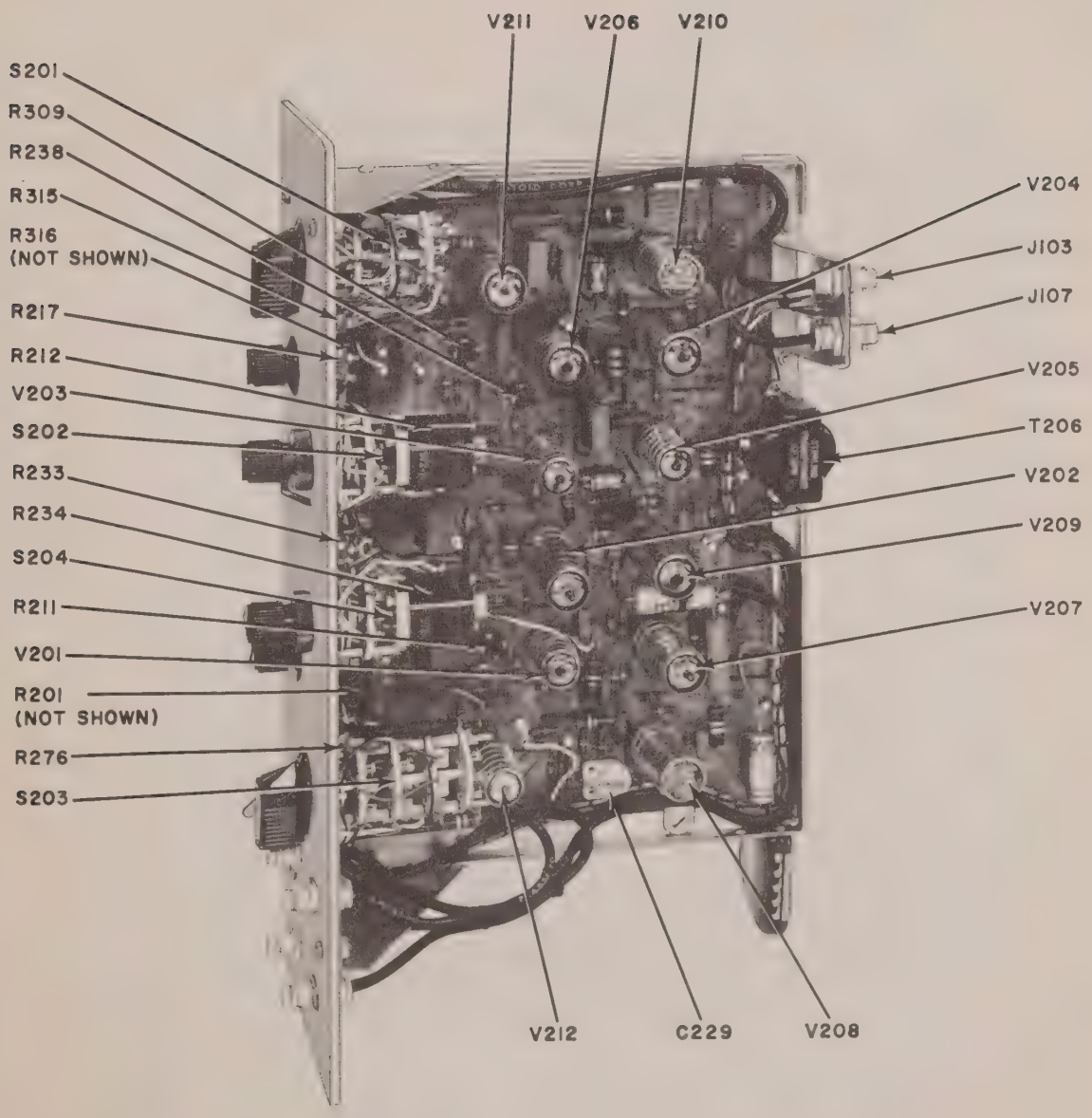


Figure 4-16. Modulator Assembly, Component Layout

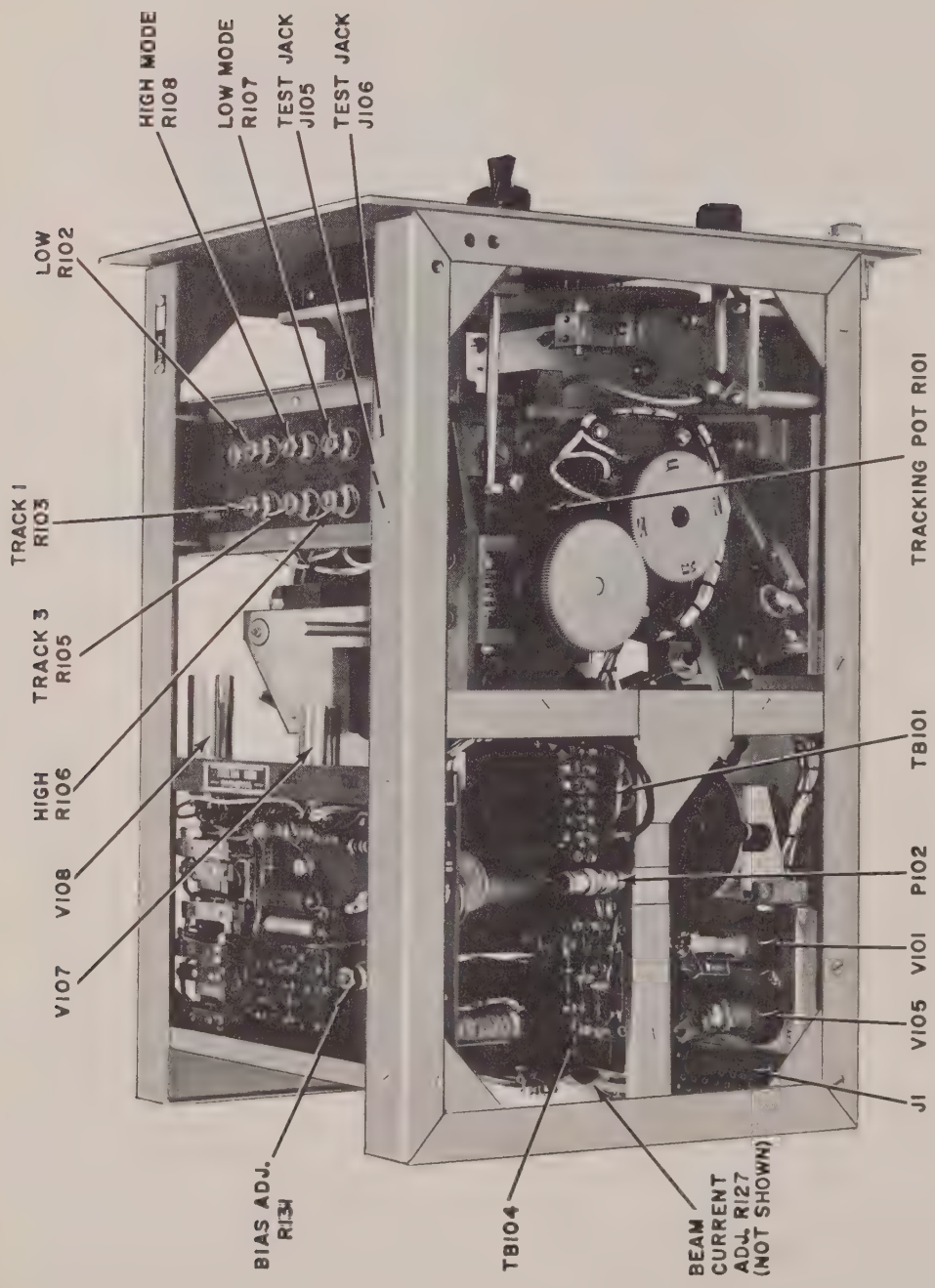


Figure 4-17. R-F Tuning Head

TABLE 4-4. TROUBLESHOOTING PROCEDURE

Step		Test Point	Instructions	Normal Indication	If Indication Is Abnormal	Remarks
Major	Minor					
1		Power monitor meter M1	Set MODULATION SELECTOR switch S203 to ZERO SET. Adjust ZERO SET control R51 to obtain a power monitor meter pointer deflection of ZERO.	Power monitor meter pointer deflects to ZERO. Proceed to step 2.	Check V13, V14, V15, V16, R49, Coarse Adj control R50, ZERO SET control R51 and associated circuitry. Proceed with step 1a. Power set probe and/or thermistor bridge defective. Proceed with step 1b.	
	1a	Pins 1 and 3 of V102.	Measure the voltage between pins 1 and 3 of V102 with a 20,000 ohm/volt vom.	With MODULATION SELECTOR switch S203 in the ZERO SET position, voltage at pin 1 of V102 is -10 volts with respect to pin 3. Proceed with step 1b.	Check V101, V103, V104, V105, V107, V108 and associated circuitry. Replace defective components.	
	1b	Thermistor probe cable.	De-energize equipment. Disconnect J102 and P102. Measure d-c resistance of thermistor probe.	Ohmmeter indicates approximately 1000 ohms. Proceed to step 1c.	Replace defective thermistor probe assembly.	Refer to paragrah 4-20.
	1c	Thermistor bridge components.	Check thermistor bridge components.		Replace defective components where necessary.	Refer to paragraph 4-22.
2		Power monitor meter M1.	Set MODULATION SELECTOR switch S203 to CW. Adjust POWER SET control to obtain a power monitor meter deflection of POWER SET.	Power monitor meter pointer deflects to POWER SET. Proceed to step 3.	Check V1 through V11 and associated circuitry. Reflex klystron V102 defective and/or repeller voltage improperly tracked. Proceed to step 2a.	

(Cont'd)

TABLE 4-4. TROUBLESHOOTING PROCEDURE (Cont'd)

Step		Test Point	Instructions	Normal Indication	If Indication Is Abnormal	Remarks
Major	Minor					
	2a	Pin 1 and 3 of V102	Measure the voltage between pins 1 and 3 of V102 with a 20,000 ohm/volt vom.	With MODULATION SELECTOR switch S203 in the CW position, voltage at pin 1 of V102 is +10 volts with respect to pin 3. Proceed with step 2b.	Check V101, V103, V104, V105, V107, V108 and associated circuitry. Replace defective parts.	
	2b	Resistor R5	De-energize MSG-34. Connect a d-c voltmeter across resister R5. Energize MSG-34. Note d-c voltmeter indication.	With MODULATION SELECTOR switch S203 in the CW position, d-c voltmeter indicates 1.25 volts d-c. Remove d-c voltmeter. Proceed with step 2c.	Adjust Beam Current Adj control R127 to obtain d-c voltmeter reading of 1.25 volts with MODULATION SELECTOR switch S203 in CW position only.	If proper d-c voltmeter indication cannot be obtained, replace klystron V102. Refer to paragraphs 4-25 and 4-38. Note Repeat all precedent steps before replacing klystron V102.
	2c	RF OUT connector J101.	With equipment de-energized, measure d-c resistance between center conductor of RF OUT connector and chassis ground with vom.	Ohmmeter indicates 50 $\pm$ 5 ohms.	Output attenuator defective, replace.	Refer to paragraph 4-24.

(Cont'd)

TABLE 4-4. TROUBLESHOOTING PROCEDURE (Cont'd)

Step		Test Point	Instructions	Normal Indications	If Indication Is Abnormal	Remarks
Major	Minor					
3		RF OUT connector J101.	Connect equipment as illustrated in Figure 4-2. Program MSG-34 for CW operation. (Refer to paragraph 2-11.) Track the MSG-34 in 200mc increments from the low end to the high end of the band as indicated on the FREQUENCY KILO-MEGACYCLES dial. At each point of the dial, zero-set, power-set, and adjust ATTENUATOR control for a 0 dbm r-f output as indicated on -DBM MICROVOLTS dial. At each point on the dial, adjust frequency meter to obtain a dip in the power meter pointer deflection. Note indication on frequency meter.	At each point the frequency indicated on absorption-type frequency meter is ± 1% of that indicated on the FREQUENCY KILO-MEGACYCLES dial.	Track reflex klystron repeller voltage.	Refer to paragraph 4-38.
4		RF OUT connector J101.	Connect equipment as illustrated in Figure 4-3. Program MSG-34 for internally sychronized square-wave modulated operation. (Refer to paragraph 2-12.) Check repetition frequency of square-wave-modulated r-f output.	Repetition frequency of internally synchronized square-wave-modulated r-f output signal adjustable from 10 to 10,000 cps by means of RATE CYCLES/SECOND control R212 and RATE CYCLES/SECOND multiplier switch S202. Asymmetry does not exceed ± 10%.	Check V201, V202, V203, V107, V108 and associated circuitry. Replace defective component (s), where necessary.	Refer to paragraph 4-29 to adjust the minimum repetition rate. Refer to paragraph 4-30 to adjust the symmetry of the square wave output of the rate generator.

(Cont'd)

TABLE 4-4. TROUBLESHOOTING PROCEDURE (Cont'd)

Step		Test Point	Instructions	Normal Indications	If Indication is Abnormal	Remarks
Major	Minor					
5		UNDELAYED SYNC OUT connector J203.	Connect equipment as illustrated in Figure 4-5. Program MSG-34 for internally synchronized pulse-modulated operation. (Refer to paragraph 2-13.) Check undelayed sync output pulse.	Pulse obtained at UNDELAYED SYNC OUT connector is positive, 15 volts peak (minimum), and has a rise time of less than 0.1 microsecond. Pulse repetition rate is variable from 10 to 10,000 pps.	Check V209 and associated circuitry. Replace defective component (s) where necessary.	
6		DELAYED SYNC OUT connector J204.	Connect equipment as illustrated in Figure 4-6. Program MSG-34 for internally sychronized pulse-modulated operation. (Refer to paragraph 2-13.) Check delay of delayed sync output pulse.	Delay between start of oscilloscope trace and leading edge of delayed sync output pulse adjustable from 2 to 2000 microseconds by means of DELAY MICROSECONDS control R234 and DELAY MICROSECONDS multiplier switch S204.	Check V209, V205, V204, and V206 and associated circuitry. Replace defective component (s) where necessary.	Refer to paragraph 4-31 to adjust the minimum delay. Refer to paragraph 4-32 to adjust the maximum delay.
7		RF OUT connector J101.	Connect equipment as illustrated in Figure 4-4. Program MSG-34 for internally synchronized pulse modulated operation. (Refer to paragraph 2-13.) With DELAY MICROSECONDS control R234 and DELAY MICROSECONDS switch S204 adjusted for minimum delay, check width of detected r-f output pulse.	Width of detected r-f output pulse adjustable from 0.2 to 10 microseconds by means of PULSE WIDTH MICROSECONDS control R316.	Check V210 and V211 and associated circuitry. Replace defective component (s) where necessary.	Refer to paragraph 4-33 to adjust the minimum width of r-f output pulse.

(Cont'd)

TABLE 4-4. TROUBLESHOOTING PROCEDURE (Cont'd)

Step		Test Point	Instructions	Normal Indications	If Indication Is Abnormal	Remarks
Major	Minor					
8		RF OUT connector J101.	Connect equipment as illustrated in Figure 4-8. Program MSG-34 for internally synchronized frequency-modulated operation. (Refer to paragraph 2-16.) With FM AMP control R 201 set fully clockwise, check frequency excursion from end to end of detected frequency-modulated output (see Figure 4-9.)	Frequency deviation of modulated r-f output pulse at least ± 2.5mc. Refer to figure 4-9.	Check V201 and associated circuitry. Replace defective component (s) if necessary.	
9		FM Output connector J107.	Connect equipment as illustrated in Figure 4-13. Program MSG-34 for internally sychronized frequency-modulated operation. (Refer to paragraph 2-16.) With FM AMP control set fully clockwise wise, check for sawtooth output signal at FM output connector J103.	Sawtooth signal available at FM output connector J107.	Check S203D and S201C and associated circuitry. Replace defective component (s) if necessary.	

(Cont'd)

TABLE 4-4. TROUBLESHOOTING PROCEDURE (Cont'd)

Step		Test Point	Instructions	Normal Indications	If Indication Is Abnormal	Remarks
Major	Minor					
10		RF OUT connector J101.	Connect equipment as show shown in Figure 4-10. Program the MSG-34 for externally pulse-modulated operation. (Refer to paragraph 2-15.) Adjust pulse width of external source from 0.2 to 100 microseconds and repetition rate from 10 to 10,000 pps. Check output r-f pulse characteristics.	R-f output pulses have same pulse width and repetition rate as modulating pulse.	Check V212 and associated circuitry. Replace defective component (s), if necessary.	
11		RF OUT connector J101.	Connect equipment as illustrated in Figure 4-7. Program the MSG-34 for externally synchronized pulse-modulated operation. (Refer to paragraph 2-15.) With DELAY MICROSECONDS control R234 and DELAY MICROSECONDS multiplier switch S204 adjusted for minimum delay, rotate PULSE WIDTH MICROSECONDS control R316 fully clockwise. Check r-f pulse output as repetition rate of pulse generator is varied from 10 to 10,000 pps.	Output r-f pulse can be externally synchronized by signal having a repetition rate varying from 10 to 10,000 pps.	Check V207 and V208 and associated circuitry. Replace defective component (s), if necessary.	

(Cont'd)

TABLE 4-4. TROUBLESHOOTING PROCEDURE (Cont'd)

Step		Test Point	Instructions	Normal Indications	If Indication Is Abnormal	Remarks
Major	Minor					
12		RF OUT connector J101.	Connect equipment as illustrated in Figure 4-12. Program MSG-34 for externally frequency-modulation operation. (Refer to paragraph 2-17.) Adjust amplitude of external modulation signal from 0 to 50 volts and the repetition frequency from 10 cps to 100 kc. Check the frequency deviation.	Modulated output pulse has frequency deviation of at least 5mc.	Check S201C. Replace, if necessary.	

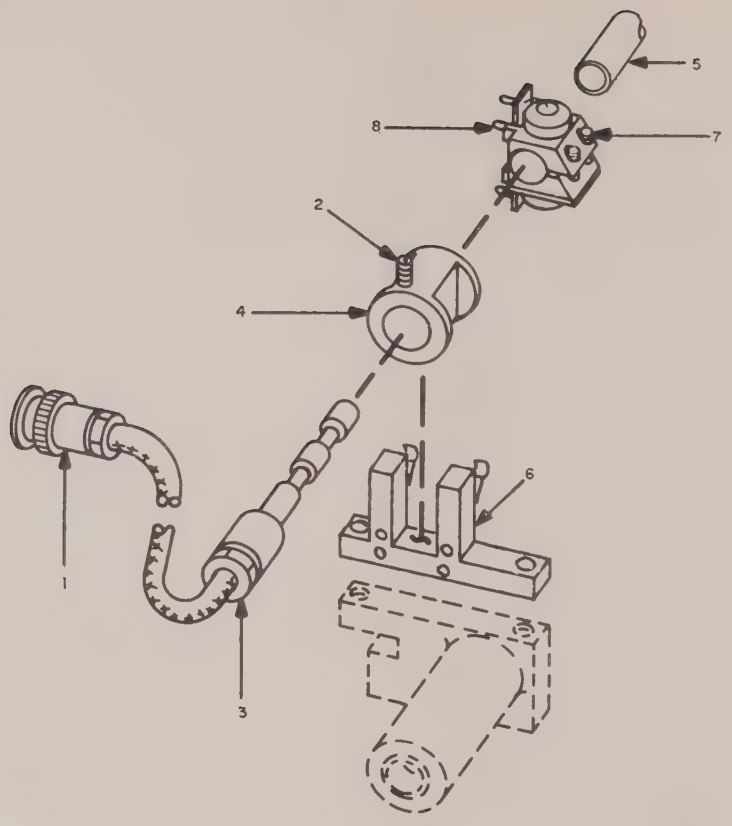


Figure 4-18. Thermistor Probe and Thermistor Compensator Assemblies, Exploded View

c. Carefully slide the thermistor compensator assembly from the thermistor probe barrel.

4-22. REPLACEMENT OF THERMISTOR COMPENSATOR ASSEMBLY. To replace the thermistor compensator assembly, proceed as outlined in the following steps: (See figure 4-18).

a. Carefully slide the thermistor compensator assembly (8, figure 4-18) onto the thermistor probe barrel (5, figure 4-18).

b. Tighten the two fillister-head screws (7, figure 4-18) to secure the thermistor compensator assembly to the thermistor probe barrel.

c. Replace the thermistor probe assembly as outlined in paragraph 4-20.

4-23. REMOVAL OF ATTENUATOR PROBE ASSEMBLY. To remove the attenuator probe assembly, proceed as outlined in the following steps:

a. Rotate the ATTENUATOR control fully clockwise.

b. Loosen and remove the round-head screw (1, figure 4-19) that secures the cable clamp (2, figure 4-19) to the bearing plate.

c. Loosen and remove the four screws that secure the RF OUT connector (3, figure 4-19) to the r-f head front panel.

d. Remove the RF OUT connector from its mounting hole.

e. Loosen the two setscrews (4, figure 4-19) that secure the attenuator probe collar (5, figure 4-19) to the attenuator probe assembly (6, figure 4-19).

f. Carefully slide the attenuator probe assembly from the attenuator barrel (7, figure 4-19) and the yoke stand (8, figure 4-19).

4-24. REPLACEMENT OF ATTENUATOR PROBE ASSEMBLY. To replace the attenuator probe assembly, proceed as outlined in the following steps:

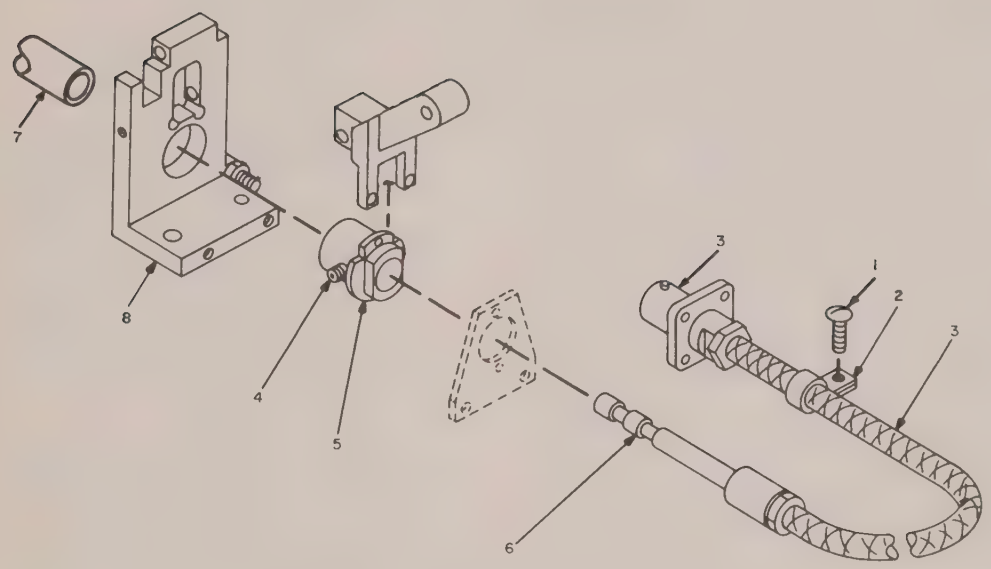


Figure 4-19. Attenuator Probe Assembly, Exploded View

a. Rotate the ATTENUATOR control fully clockwise.

b. Rotate the POWER SET control fully clockwise.

Note

Proper orientation of the attenuator probe assembly is established by setting the grounded edge of the assembly away from the klystron protective cover.

c. Carefully insert the replacement attenuator probe assembly (6, figure 4-19) through the yoke stand (8, figure 4-19) and into the attenuator barrel (7, figure 4-19).

CAUTION

ADVANCING THE ATTENUATOR TOO DEEPLY INTO THE KLYSTRON CAVITY WILL DAMAGE THE CAVITY.

d. Carefully advance the attenuator probe assembly until the probe tip just touches the hat located within the attenuator probe barrel.

e. Back off the attenuator probe assembly 1/32 inch.

f. Tighten the two setscrews (4, figure 4-19) to secure the attenuator probe collar (5, figure 4-19) to the attenuator probe.

g. Replace the RF OUT connector (3, figure

4-19) in its mounting hole and secure the connector to the r-f head front panel.

h. Secure the cable clamp (2, figure 4-19) to the bearing plate by tightening the round-head screw (1, figure 4-19).

i. Calibrate the r-f power output of the MSG-34 as outlined in paragraph 4-39.

4-25. REPLACEMENT OF REFLEX KLYSTRON OSCILLATOR TUBE. To replace the reflex klystron oscillator tube, proceed as outlined in the following steps: (See figure 4-20.)

WARNING

THIS EQUIPMENT EMPLOYS HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. DO NOT ATTEMPT TO REPLACE THE REFLEX KLYSTRON OSCILLATOR TUBE UNLESS OPERATING POWER HAS BEEN REMOVED FROM THE POWER INPUT 50-60 CPS RECEPTACLE.

a. Loosen the single strap-clamp screw that secures the klystron cover to the klystron clamp.

b. Carefully remove the klystron cover. The klystron clamp, klystron tube socket, the protruding base of the reflex klystron oscillator tube, and the oscillator cavity will now be visible.

c. Carefully remove the klystron tube socket from the base connectors of the reflex klystron tube.

d. Place the klystron wrench (supplied with the equipment) over the protruding portion of the reflex klystron tube. Move the wrench toward the oscillator barrel until contact is made with the klystron clamp. Rotate the klystron wrench until its pins engage the holes in the klystron clamp.

e. Gently, but with pressure if necessary, rotate the klystron wrench one-half turn counterclockwise.

f. Remove the klystron wrench.

g. Grasp the protruding portion of the reflex klystron tube and, with a clockwise twisting motion, slowly withdraw it from the oscillator cavity.

h. Insert the replacement reflex klystron tube into the oscillator cavity, applying a clockwise twisting motion to the base of the tube as it enters the cavity. A slight but noticeable resistance will be felt as the reflex klystron contact ring engages the toroidal spring located within the cavity. Continue twisting the tube, while simultaneously pressing it further into the cavity, until two distinct clicks are heard and a positive stop is encountered. At this point the reflex klystron tube is properly seated within the oscillator cavity.

i. Place the klystron wrench over the protruding base of the replacement reflex klystron tube. Move the wrench toward the tube until contact is made with the klystron clamp. Rotate the klystron wrench until its pins engage the holes in the klystron clamp.

j. Rotate the klystron wrench clockwise to secure the reflex klystron tube within the oscillator cavity.

k. Remove the wrench.

CAUTION

NEVER USE FORCE WHEN MATING THE REFLEX KLYSTRON TUBE SOCKET TO THE BASE CONNECTORS OF THE REPLACEMENT REFLEX KLYSTRON. SINCE IT IS POSSIBLE TO MATE THE SOCKET IN A MISALIGNED POSITION, FORCED MATING OF THE SOCKET WILL RESULT IN PERMANENT DAMAGE TO THE REPLACEMENT REFLEX KLYSTRON UPON APPLICATION OF OPERATING POWER.

l. Mate the reflex klystron tube socket to the base connectors of the replacement reflex klystron.

m. Replace the klystron protective cover over the protruding portion of the replacement reflex klystron tube so that the open end of the cover engages the klystron clamp.

n. Tighten the single strap-clamp screw to secure the klystron protective cover to the klystron clamp.

o. Rotate Beam Current Adj control R127 fully counterclockwise.

p. Refer to paragraph 4-38 for tracking the repeller voltage of the replacement reflex klystron.

4—26. ADJUSTMENT AND CALIBRATION PROCEDURES.

4-27. Adjustment and calibration procedures for the MSG-34 are given in paragraph 4-28 through 4-39.

4-28. ADJUSTING OUTPUT LEVEL OF +210 VOLT SUPPLY. To adjust the output level of the +210 volt supply, proceed as outlined in the following steps:

a. Connect the positive probe of a d-c voltmeter to pin 1 of V20. Connect the negative probe to chassis ground.

b. Note the voltmeter indication. It should indicate +210 volts. If it does not, proceed to step c.

c. Loosen the lock nut that secures the shaft of +210V adj. control R63.

d. Adjust R63 to obtain a voltmeter indication of +210 volts.

e. Secure the shaft setting of R63 by tightening the lock nut.

f. Recheck the voltmeter indication after tightening the lock nut.

4-29. SETTING LOW FREQ. ADJ. CONTROL R217. To adjust the repetition rate of the rate generator at the low-frequency end, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT SQ WV.

b. Set the SYNC SELECTOR switch to INT.

c. Set the RATE CYCLES/SECOND control to 10.

d. Set the RATE CYCLES/SECOND multiplier switch to X1.

e. Connect an electronic counter, such as the Hewlett-Packard Model 523DR, to pin 1 of V202 through a 0.001 microfarad capacitor.

f. Note the indication of the electronic counter. It should indicate a repetition rate of 10 pps. If it does not, proceed to step g.

g. Adjust R217 to obtain an electronic counter indication of 10 pps.

4-30. SETTING SQ WV SYMMETRY ADJ CONTROL R211. To adjust the symmetry of the square-wave output of the rate generator, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT SQ WV.

b. Set the SYNC SELECTOR switch to INT.

c. Set the RATE CYCLES/SECOND control to 50.

d. Set the RATE CYCLES/SECOND multiplier switch to X100.

e. Connect the probe of the oscilloscope to pin 1 of V202 through a 0.001 microfarad capacitor.

f. Note the oscilloscope display. The square-wave signal should have an asymmetry of less than ±10%. If it does not, proceed to step g.

g. Loosen the lock nut that secures the shaft of Sq. Wv. Symmetry Adj. control R211.

h. Adjust R211 to obtain an oscilloscope display of maximum symmetry.

i. Secure the shaft of R211 by tightening the lock nut. If lock nut does not appear, apply glyptol.

j. Recheck the oscilloscope display after tightening the lock nut.

4-31. SETTING MIN DELAY ADJ CONTROL R233. To adjust the minimum delay of the delayed sync output pulse, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT PULSE.

b. Set the SYNC SELECTOR switch to INT.

c. Set the DELAY MICROSECONDS control to 2.

d. Set the DELAY MICROSECONDS multiplier switch to X1.

e. Connect the UNDELAYED SYNC OUT connector to the external trigger terminals of an oscilloscope.

f. Connect the DELAYED SYNC OUT connector to the vertical input terminals of the oscilloscope.

g. Note the delay between the beginning of the sweep and the delayed sync output pulse. It should be 2 microseconds. If it is not, proceed to step h.

h. Adjust R233 to obtain a 2 microsecond delay between the start of the oscilloscope sweep and the delayed sync output pulse.

Note

If there is an absence of the delayed sync output pulse, adjust R238 to the point where V206B conducts but does not free-run.

4-32. SETTING MAX DELAY ADJ CONTROL R276. To adjust the maximum delay of the delayed sync output pulse, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT PULSE.

b. Set the SYNC SELECTOR switch to INT.

c. Set the DELAY MICROSECONDS control to 20.

d. Set the DELAY MICROSECONDS multiplier switch to X100.

e. Connect the UNDELAYED SYNC OUT connector to the external trigger terminals of an oscilloscope.

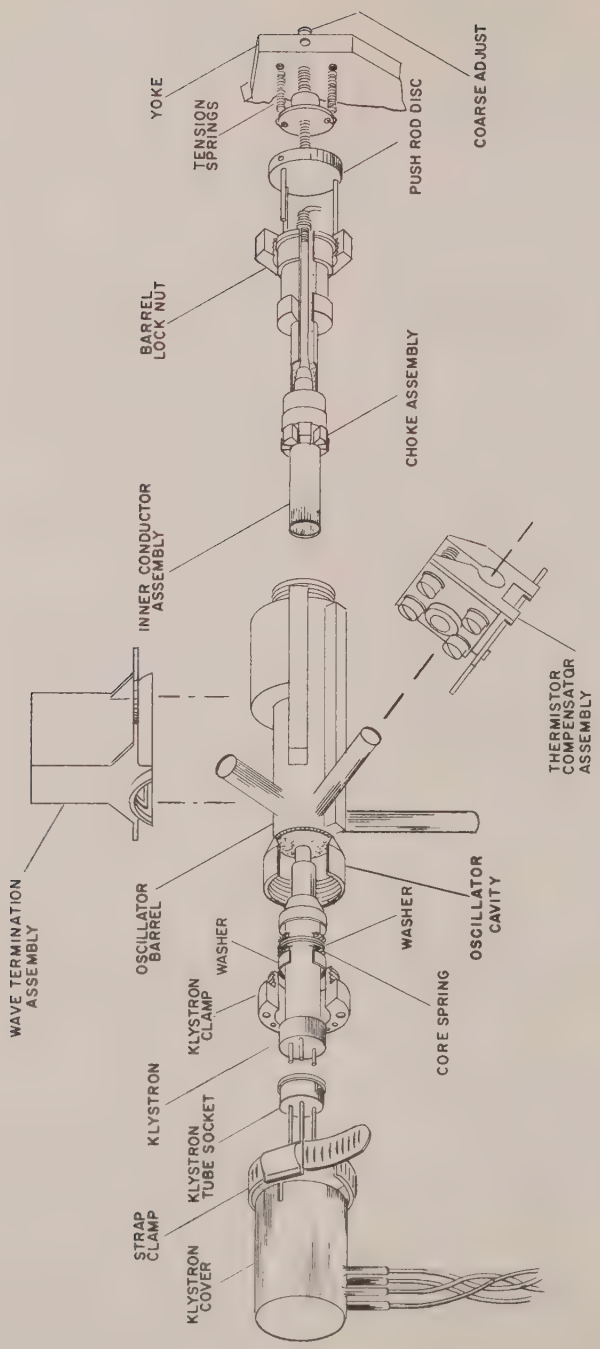


Figure 4-20. Reflex Klystron Oscillator, Exploded View

f. Connect the DELAYED SYNC OUT connector to the vertical input terminals of the oscilloscope.

g. Note the delay between the beginning of the sweep and the delayed sync output pulse. It should be 2,000 microseconds. If it is not, proceed to step h.

h. Adjust R276 to obtain 2,000-microsecond delay between the start of the oscilloscope sweep and the delayed sync output pulse.

4-33. SETTING MIN. WIDTH ADJ. CONTROL R315. To adjust the minimum width of the r-f output pulse, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT PULSE.

b. Set the SYNC SELECTOR switch to INT.

c. Set the PULSE WIDTH MICROSECONDS control to 0.2.

d. Connect the external trigger terminals of an oscilloscope to the UNDELAYED SYNC OUT connector.

e. Set the DELAY MICROSECONDS control to 2.

f. Set the DELAY MICROSECONDS multiplier switch to X1.

g. Connect the probe of the oscilloscope to pin 3 of V210 through a 0.001 microfarad capacitor.

h. Note the oscilloscope display. It should be a pulse of 0.2 microseconds width. If it is not, proceed to step i.

i. Adjust R315 to obtain a 0.2 microsecond pulse on the oscilloscope display.

4-34. SETTING BIAS ADJ. CONTROL R309. To adjust the bias voltage on the control grid of V211, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT PULSE.

b. Set the SYNC SELECTOR switch to +EXT.

c. Connect the negative probe of a d-c voltmeter to pin 2 of V211. Connect the positive probe to chassis ground.

d. Note the indication of the voltmeter. It should indicate -20 volts. If it does not, proceed to step e.

e. Loosen the lock nut that secures the shaft of Bias Adj control R309.

f. Adjust R309 to obtain a voltmeter indication of -20 volts.

g. Set the SYNC SELECTOR switch to INT.

h. Connect the external trigger terminals of an oscilloscope to the DELAYED SYNC OUT connector.

i. Connect the probe of the oscilloscope to pin 6 of V211.

j. Note the oscilloscope display. A good, clean pulse should be observed.

k. Tighten the lock nut that secures the shaft of R309. If lock nut does not appear, apply glyptol.

l. Recheck the bias voltage after tightening the lock nut.

4-35. SETTING BIAS ADJ CONTROL R238. To adjust the bias voltage of V206A, proceed as outlined in the following steps:

a. Set the MODULATION SELECTOR switch to INT PULSE.

b. Set the SYNC SELECTOR to +EXT.

c. Connect the negative probe of a d-c voltmeter to pin 2 of V206. Connect the positive probe to chassis ground.

d. Note the indication of the d-c voltmeter. It should indicate -22 volts. If it does not, proceed with step e.

e. Loosen the lock nut that secures the shaft of Bias Adj control R238.

f. Adjust R238 to obtain a d-c voltmeter indication of -22 volts.

g. Set the SYNC SELECTOR switch to INT.

h. Connect the external trigger terminals of an oscilloscope to the DELAYED SYNC OUT connector.

i. Connect the probe of the oscilloscope to pin 3 of V206.

j. Note the oscilloscope. A good, clean pulse should be observed.

k. Tighten the lock nut that secures the shaft of R238. If lock nut does not appear, apply glyptol.

l. Recheck the bias voltage after tightening the lock nut.

4-36. ADJUSTING OUTPUT LEVEL OF BEAM SUPPLY. To adjust the output level of the beam supply, proceed as outlined in the following steps:

a. Connect the Fluke Model 80B5 Volt Box between pin 4 of V2 and chassis ground.

b. Connect the Fluke Model 801 Differential

Voltmeter to the output terminals of the volt box.

c. Note the indication of the differential voltmeter. It should indicate -1250 volts. If it does not, proceed to step d.

d. Loosen the lock nut that secures the shaft of -1250V Adj control R8.

e. Adjust R8 to obtain a differential voltmeter indication of -1250 volts.

f. Secure the shaft of R8 by tightening the lock nut.

g. Recheck the indication of the differential voltmeter after tightening the lock nut.

4-37. ADJUSTING OUTPUT LEVEL OF REPELLER SUPPLY. To adjust the output level of the repeller supply, proceed as outlined in the following steps.

a. Connect the Fluke Model 80B5 Volt Box between the junction of High Mode 2-3/4 Adj control R106, High Mode 3-3/4 Adj control R105, and R109 and chassis ground.

b. Connect the Fluke Model 801 Differential Voltmeter to the output terminals of the volt box.

c. Note the indication of the differential voltmeter. It should indicate -1850 volts. If it does not, proceed to step d.

d. Loosen the lock nut that secures the shaft of -1850V Adj control R31.

e. Adjust R31 to obtain a differential voltmeter indication of -1850 volts.

f. Secure the shaft of R31 by tightening the lock nut.

g. Recheck the indication of the differential voltmeter after tightening the lock nut.

4-38. REPELLER VOLTAGE TRACKING. Due to variations in reflex klystron tube characteristics, the replacement of the reflex klystron r-f oscillator tube will necessitate retracking of the repeller voltage. To track the repeller voltage of the reflex klystron r-f oscillator, proceed as outlined in the following steps.

a. Connect a RG-9A/U cable supplied between the RF OUT connector and the input connector of a frequency meter, as shown in figure 4-21.

b. Connect a crystal detector, having a d-c return, to the output connector of the frequency meter, as shown in figure 4-21.

c. Connect the vertical input terminals of a high-gain oscilloscope across the output of the crystal detector, as shown in figure 4-21.

d. Connect the "reflector" terminals of a Polarad Model MK-1 Klystron Mode Alignment Modulator to the r-f head repeller test points, J105 and J106, as shown in figure 4-21.

e. Connect the horizontal input terminals of the high-gain oscilloscope to the "h scope" and "ground" terminals of the Model MK-1, as shown in figure 4-21.

f. Apply operating power to the MSG-34.

g. Set the POWER switch to ON and allow the MSG-34 to warm up for at least 15 minutes.

Note

Make sure MODULATION SELECTOR switch S203 is in the CW position.

h. Connect the negative probe of a d-c voltmeter to chassis ground. Connect the positive probe to pin 1 of V5.

i. Adjust Beam Current Adj control R127 to obtain a voltmeter indication of 1.25 volts. This sets the reflex klystron beam current at the proper value.

j. Remove the d-c voltmeter.

k. Rotate the RF OSC control to position the cam follower at the fixed point of the adjustable periphery tuning cam. (See figure 4-22.)

l. Adjust the ATTENUATOR control and the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen, as shown in figure 4-23a. If the mode pattern does not appear, proceed as outlined in the following additional steps.

(1) Rotate the RF OSC control toward the high end of the band until the high-end mode switch is actuated. Reverse rotation to reactuate the high-end mode switch.

(2) Center the mode pattern on the oscilloscope screen, as shown in figure 4-23b, by adjusting High Mode 3-3/4 Adj. control R105.

(3) Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-23c.

(4) Connect the positive probe of a d-c vtvm to pin 6 of V2. Connect the common probe to pin 1 of V101.

(5) Note the reading of the vtvm. A reading between the limits of +220 and +290 volts indicates that the reflex klystron is operating in the desired 3-3/4-wave repeller mode.

(6) Rotate the RF OSC control toward the low end of the band until the low-end mode switch

Section IV
Maintenance

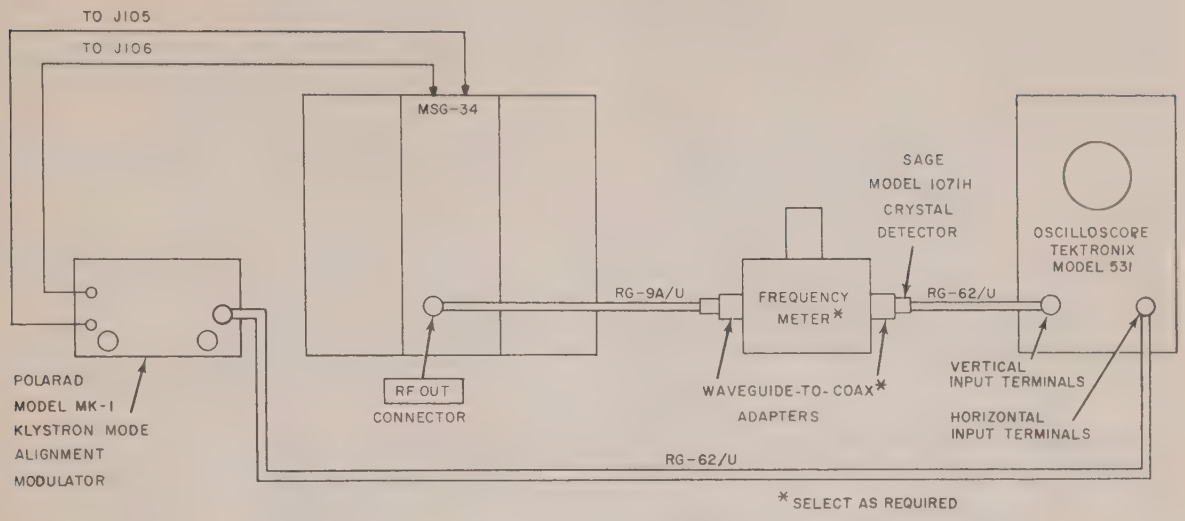


Figure 4-21. Tracking Repeller Voltage, Equipment Setup

is actuated. Reverse rotation to reactuate the low-end mode switch.

(7) Center the mode pattern on the oscilloscope screen by adjusting Low Mode 3-3/4 Adj control R-107.

(8) Note the reading of the vtvm. A reading between the limits of +50 and +100 volts indicates that the reflex klystron is operating in the desired 3-3/4-wave repeller mode.

(9) Rotate the RF OSC control toward the low end of the band until the low-end mode switch is again actuated.

(10) Center the mode pattern on the oscilloscope screen by adjusting High Mode 2-3/4 Adj control R106.

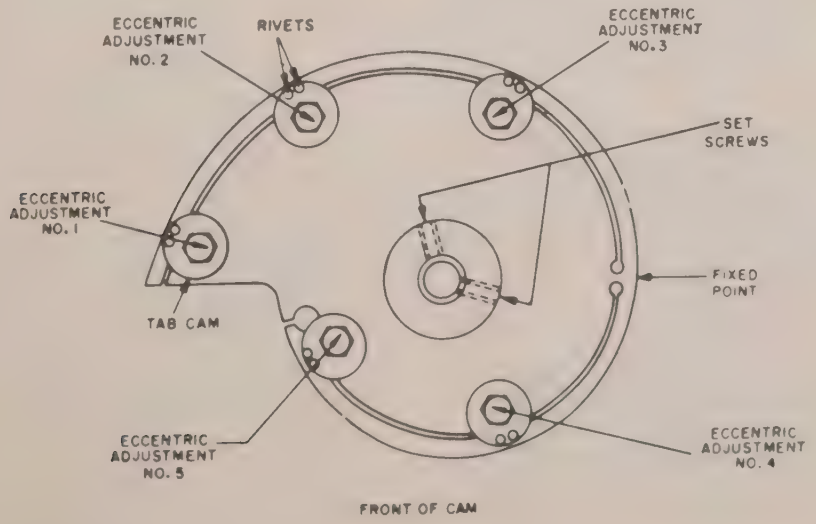


Figure 4-22. Typical Adjustable Periphery Tuning Cam

(11) Note the vtvm reading. A reading between the limits of +275 and +360 volts indicates that the reflex klystron is operating in the desired 2-3/4-wave repeller mode.

(12) Rotate the RF OSC control to the low end of the band.

(13) Center the mode pattern on the oscilloscope screen by adjusting Low Mode 2-3/4 Adj control R102.

(14) Note the vtvm reading. A reading between the limits of +75 and +150 volts indicates that the reflex klystron is operating in the desired 2-3/4-wave repeller mode.

(15) Rotate the RF OSC control toward the high end of the band, past the point of low-end mode switching, until the high-end mode switch is actuated.

(16) Center the mode pattern on the oscilloscope screen by adjusting Low Mode 4-3/4 Adj control R108.

(17) Note the vtvm reading. A reading between the limits of +75 and +140 volts indicates that the reflex klystron is operating in the desired 4-3/4-wave repeller mode.

(18) Rotate the RF OSC control to the high end of the band.

(19) Center the mode pattern on the oscilloscope screen by adjusting High Mode 4-3/4 Adj control R103.

(20) Note the vtvm reading. A reading between the limits of +225 and +350 volts indicates that the reflex klystron is operating in the desired 4-3/4-wave repeller mode.

Note

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the frequency of the r-f head.

(21) Remove the vtvm.

m. Rotate the RF OSC control from one end of the band to the other. The mode pattern displayed on the oscilloscope screen should be continuous, display no splitting or loss of power at any point, and remain centered on the oscilloscope screen.

Note

If the displayed mode pattern is erratic

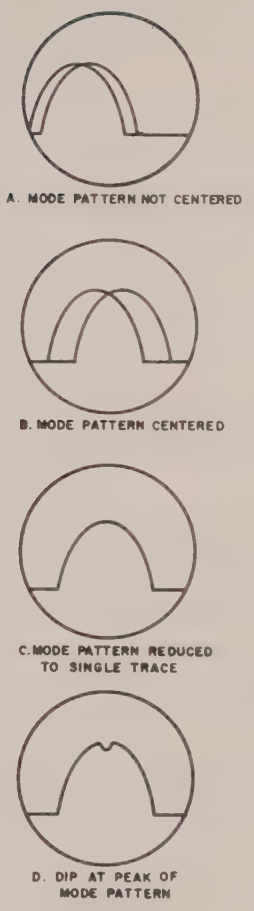


Figure 4-23. Typical Mode Pattern Displays

at any point within the band, rotate the RF OSC control to the point of discontinuity and remove operating power from the MSG-34. Loosen the single strap-clamp screw, remove the protective cover, and loosen the knurled end collar with the spanner wrench supplied. Gently twist the reflex klystron tube clockwise. Tighten the end collar and replace the protective cover. Re-energize the MSG-34 and rescan the band for discontinuities.

Since the orientation of the reflex klystron tube within the oscillator cavity cannot be anticipated for the point of optimum performance, it is suggested that the reflex klystron twisting operation be performed in 30-degree increments until continuity

throughout the band is achieved.

n. Rotate the RF OSC control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY KILOMEGACYCLES dial indication.

o. Tune the frequency meter to that frequency indicated on the FREQUENCY KILOMEGACYCLES dial.

p. Adjust the coarse frequency adjust screw (figure 4-20) to obtain a dip at the peak of the displayed mode, as shown in figure 4-23d.

q. Rotate the RF OSC control to position the cam follower at eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-22.)

r. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note the FREQUENCY KILOMEGACYCLES dial indication and the indication of the frequency meter. They should be separated by no more than ±1%.

s. Repeat steps q and r for the cam follower at eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter indication should be separated by no more than ±1% of the FREQUENCY KILOMEGACYCLES dial indication. If the frequency difference is greater, proceed as outlined in the following additional steps:

CAUTION

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

(1) If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error occurs at the low end of the band, loosen, in the order stated, eccentric adjustment bolts no. 4 and 5.

(2) With the cam follower resting at the fixed point of the adjustable periphery tuning cam, rotate the RF OSC control to the high end of the band or to the low end, as required, until the cam follower rests at eccentric adjustment bolt no. 3 or 4, respectively.

(3) Note the FREQUENCY KILOMEGACYCLES dial indication. Tune the frequency meter to this frequency.

(4) Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode.

(5) Tighten the eccentric adjustment bolt.

(6) Repeat steps (2) through (5) for the remaining eccentric adjustment bolts.

t. Remove the leads from the repeller test points.

4-39. POWER OUTPUT CALIBRATION. To calibrate the power output of the MSG-34 after the replacement of the output attenuator probe, thermistor probe, thermistor compensator, or reflex klystron oscillator tube, proceed as outlined in the following steps:

a. With the MSG-34 in an operative state, set the MODULATION SELECTOR switch to ZERO SET.

b. Rotate the ZERO SET control fully clockwise.

c. Adjust Coarse Adj control R50 to obtain a power monitor meter pointer deflection of full-scale.

d. Adjust the ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

e. Rotate the ATTENUATOR control fully counterclockwise.

f. Set the MODULATION SELECTOR switch to CW.

g. Connect a microwave power meter, such as the Hewlett-Packard Model 430C Microwave Power Meter, to the RF OUT connector through a thermistor mount, such as the Hewlett-Packard Model 477B Thermistor Mount.

h. Rotate the RF OSC control to the low end of the band.

i. Rotate the POWER SET control fully clockwise.

j. Loosen the two setscrews (2, figure 4-18) that secure the thermistor probe (3, figure 4-18) to the thermistor probe collar (4, figure 4-18).

CAUTION

CARE SHOULD BE EXERCISED SO AS NOT TO DAMAGE THE HATS THAT ARE LOCATED WITHIN THE OSCILLATOR CAVITY. SHOULD THESE HATS BE BENT OR DAMAGED IN ANY WAY, BOTH THE FREQUENCY AND POWER ALIGNMENT OF THE MSG-34 WILL BE VOID.

k. Carefully adjust the degree of insertion of the

thermistor probe within the thermistor probe barrel (5, figure 4-18) so that the power monitor meter pointer deflects to an indication approximately two-thirds the distance between the POWER SET mark and full-scale. (Closer to the full-scale mark.)

l. Tighten the two setscrews, thereby securing the thermistor probe to the thermistor probe collar.

m. Adjust the POWER SET control to obtain a power monitor meter pointer deflection of POWER SET.

n. Rotate the RF OSC control throughout the band. At various frequencies, zero-set the MSG-34 and adjust the POWER SET control to ascertain that the power monitor meter pointer is capable of deflecting both above and below the POWER SET mark.

o. Rotate the RF OSC control to the low end of the band.

p. Zero-set the MSG-34 and adjust the POWER SET control to obtain a power monitor meter pointer deflection of POWER SET.

q. Adjust the ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial beneath the hairline of the -DBM MICROVOLTS window.

r. Note the reading of the power meter (in dbm).

s. Rotate the RF OSC control throughout the band in 100 mc increments. At each point, zero-set, power-set, and adjust the ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial beneath the window hairline. Note the power meter readings at each frequency. The difference between the maximum and minimum microwave power meter readings should be ±2 db or less.

t. Substitute the values obtained for the maximum and minimum output power levels (as indicated by the power meter) into the following formula to obtain the overall db error.

$$\text{Average overall db error} = \frac{P_{max} - P_{min}}{2}$$

u. Rotate the RF OSC control to the low-power frequency.

v. Zero-set and power-set the MSG-34 at this low-power frequency.

w. Adjust the ATTENUATOR control to obtain a power meter indication corresponding to the low-power value determined in step s.

x. Remove operating power from MSG-34.

y. Remove the r-f head from the basic unit.

z. Loosen the two setscrews on the -DBM MICROVOLTS dial hub (not the gear hub), located behind the r-f head front panel, and move the dial until the 0 dbm mark lines up with the -DBM MICROVOLTS window hairline.

aa. Tighten the two setscrews.

ab. Replace the r-f head into the basic unit.

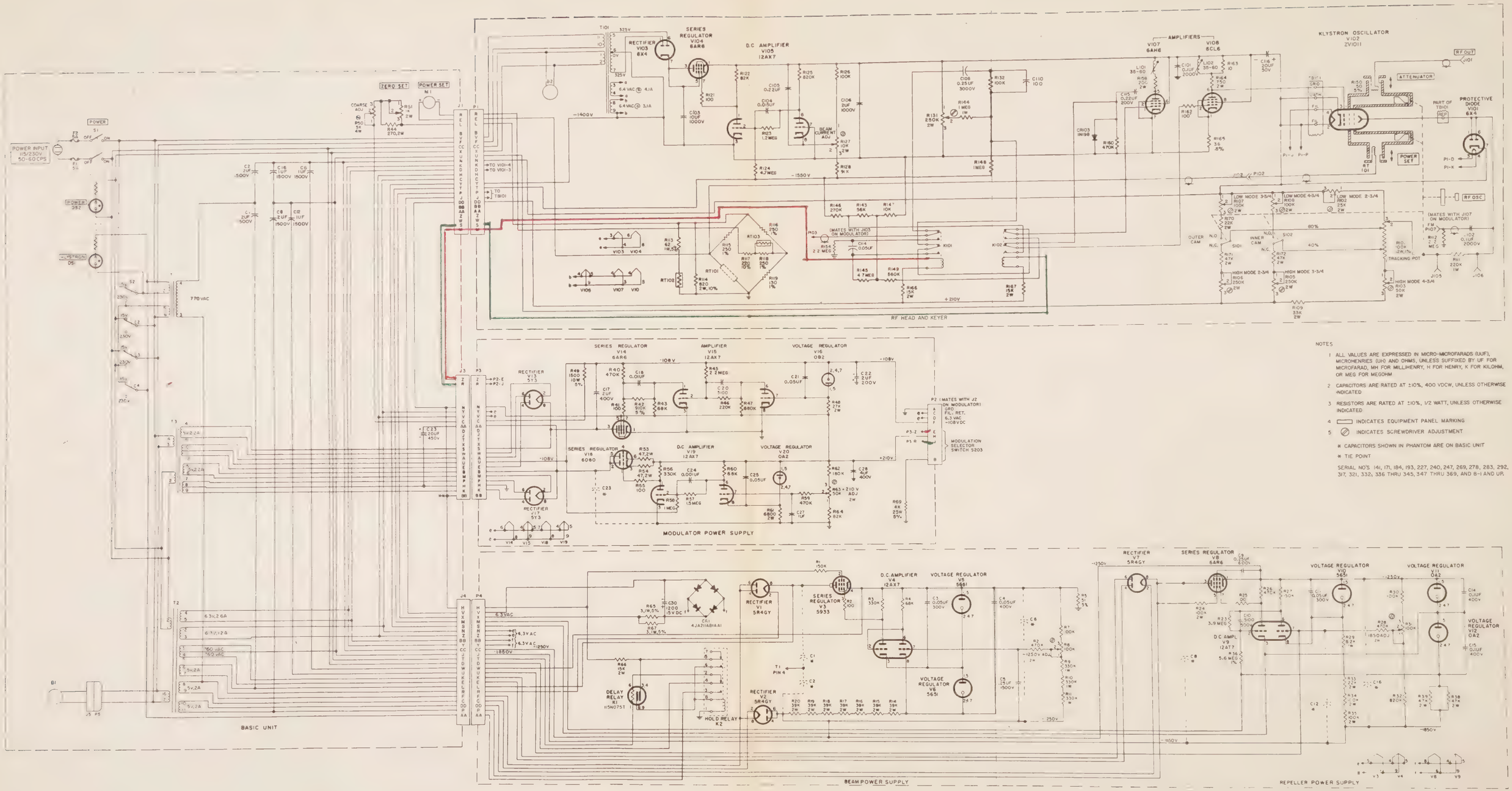
ac. Repeat steps o through r. The power meter readings for all frequencies should be 0 dbm ± 2 db.

4-40. SETTING BIAS ADJ. CONTROL R131. Bias Adj. control R131 controls the grid bias of video amplifier V107. Should readjustment become necessary, the control should be adjusted so that the pulse or square wave does not break-up or free-run when the MODULATION SELECTOR switch is set to INT SQ WV, INT PULSE, or FM.

SECTION V
DIAGRAMS AND TABLES

5—1. GENERAL.

5-2. This section contains the schematic diagrams for Model MSG-34. Voltage and resistance charts are also included as a general aid when trouble-shooting and maintaining the equipment.



NOTES

1 ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR MEG FOR MEGOHM

2 CAPACITORS ARE RATED AT ±10%, 400 VDCW, UNLESS OTHERWISE INDICATED

3 RESISTORS ARE RATED AT ±10%, 1/2 WATT, UNLESS OTHERWISE INDICATED

4 ▭ INDICATES EQUIPMENT PANEL MARKING

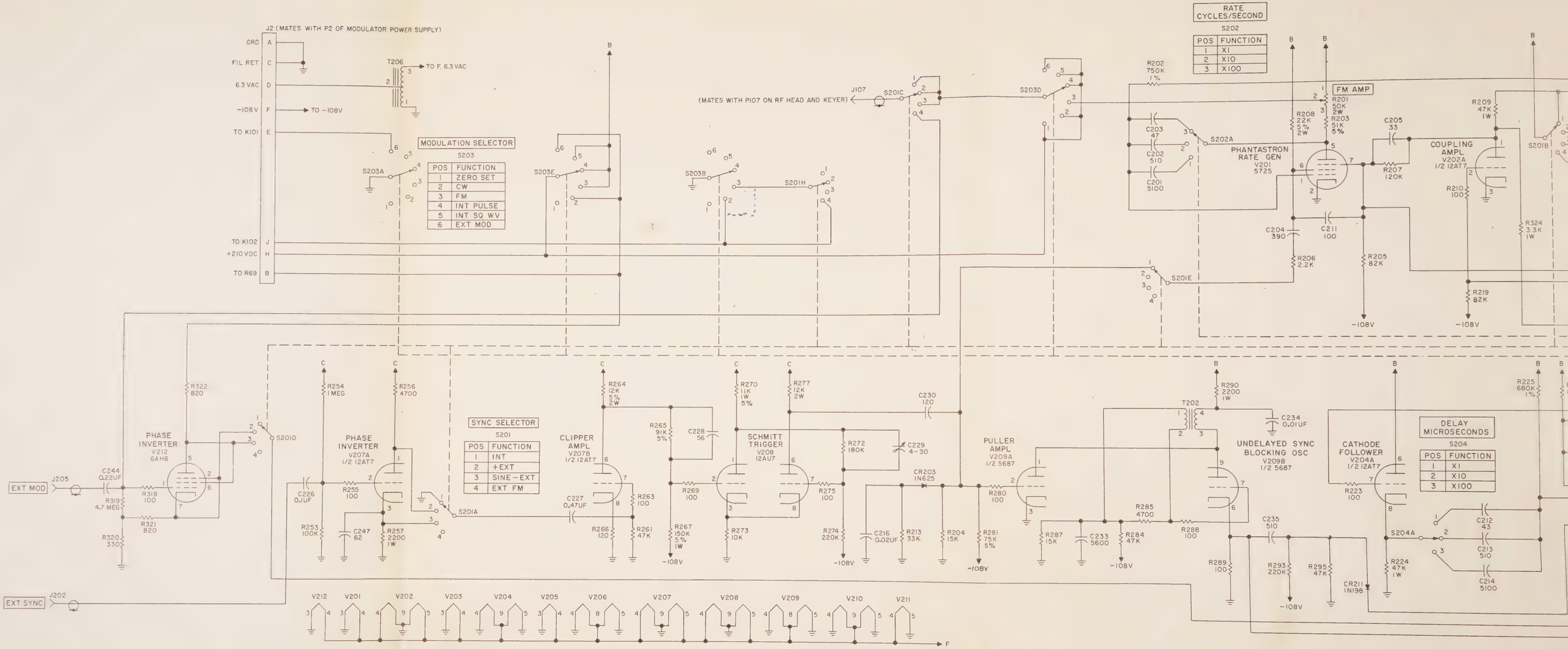
5 ⊘ INDICATES SCREWDRIVER ADJUSTMENT

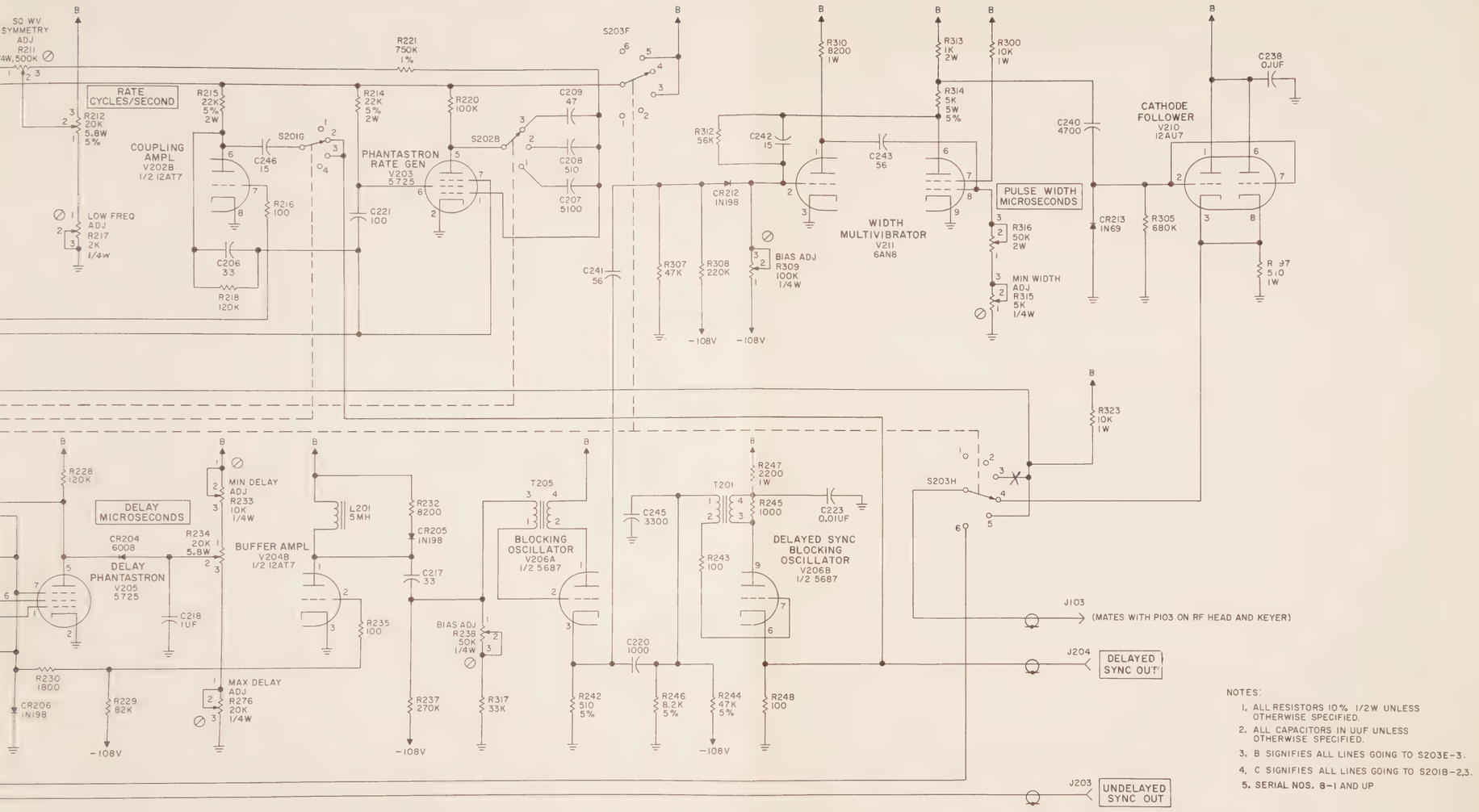
* CAPACITORS SHOWN IN PHANTOM ARE ON BASIC UNIT

* TIE POINT

SERIAL NO'S 141, 171, 184, 193, 227, 240, 247, 269, 278, 283, 292, 317, 321, 332, 336 THRU 345, 347 THRU 369, AND B-1 AND UP.

Figure 5-2. Model MSG-34 Microwave Signal Generator, Overall Schematic Diagram Less Modulator Assembly


J2 (MATES WITH P2 OF MODULATOR POWER SUPPLY)
GRD A
FIL RET C
6.3 VAC D
-108 V F
TO K101 E
TO K102 J
+210 VDC H
TO R69 B
T206
TO F. 6.3 VAC
TO -108V
MODULATION SELECTOR
S203
POS FUNCTION
1 ZERO SET
2 CW
3 FM
4 INT PULSE
5 INT SQ WV
6 EXT MOD
S203A
S203E
S203B
S201H
J107
(MATES WITH P107 ON RF HEAD AND KEYER)
S201C
S203D
RATE CYCLES/SECOND
S202
POS FUNCTION
1 X1
2 X10
3 X100
R202 750K 1%
C203 47
C202 510
C201 5100
S202A
FM AMP
R208 22K 5% 2W
R201 50K 2W
R203 51K 5%
PHANTASTRON RATE GEN
V201 5725
C205 33
R207 120K
COUPLING AMPL
V202A 1/2 12AT7
R209 47K 1W
S201B
R210 100
R324 3.3K 1W
C204 390
C211 100
R206 2.2K
R205 82K
R219 82K
-108V
S201E
PHASE INVERTER
V212 6AH6
R322 820
S201D
EXT MOD
J205
C244 0.22UF
R319 4.7 MEG
R318 100
R321 820
R320 330
PHASE INVERTER
V207A 1/2 12AT7
R254 1 MEG
R256 4700
C226 0.1UF
R255 100
R253 100K
C247 62
R257 2200 1W
SYNC SELECTOR
S201
POS FUNCTION
1 INT
2 +EXT
3 SINE-EXT
4 EXT FM
S201A
CLIPPER AMPL
V207B 1/2 12AT7
R264 12K 5% 2W
C227 0.47UF
R266 120
R263 100
R261 47K
R265 91K 5%
C228 56
R269 100
R267 150K 5% 1W
SCHMITT TRIGGER
V208 12AU7
R270 11K 1W 5%
R273 10K
R277 12K 2W
C230 120
R272 180K
C229 4-30
R275 100
R274 220K
CR203 1N625
C216 0.02UF
R213 33K
R204 15K
R281 75K 5%
PULLER AMPL
V209A 1/2 5687
R280 100
R290 2200 1W
T202
C234 0.01UF
UNDELAYED SYNC BLOCKING OSC
V209B 1/2 5687
R287 15K
C233 5600
R284 47K
R285 4700
R288 100
C235 510
R289 100
R293 220K
R295 47K
CATHODE FOLLOWER
V204A 1/2 12AT7
R225 680K 1%
R223 100
DELAY MICROSECONDS
S204
POS FUNCTION
1 X1
2 X10
3 X100
S204A
C212 43
C213 510
C214 5100
R224 47K 1W
CR211 1N198
EXT SYNC
J202
V212 V201 V202 V203 V204 V205 V206 V207 V208 V209 V210 V211
F



NOTES:

1. ALL RESISTORS 10% 1/2W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS IN UUF UNLESS OTHERWISE SPECIFIED.
3. B SIGNIFIES ALL LINES GOING TO S203E-3.
4. C SIGNIFIES ALL LINES GOING TO S201B-2,3.
5. SERIAL NOS. 8-1 AND UP

Figure 5-1. Modulator Assembly, Schematic Diagram

TABLE 5-1. VOLTAGE AND RESISTANCE MEASUREMENTS, MSG-34 POWER SUPPLIES

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV1	5R4GY	0V	+1100V	0V	950VAC	0V	950VAC	0V	+1100V		Volts
		∞	∞	∞	∞	∞	∞	∞	∞		Ohms
XV2	5R4GY	0V	950VAC	0V	-1250V	0V	-1250V	0V	950VAC		Volts
		∞	∞	∞	1 meg	∞	1 meg	∞	∞		Ohms
XV3	5933	FIL	+210V	-30V	0V	FIL					Volts
		0V	330K	300K	45	0					Ohms
XV4	12AX7	0V	-85V	-85V	FIL	FIL	-85V	-170V	-165V	FIL	Volts
		300K	70K	∞	0	0	70K	550K	120K	0	Ohms
XV5	5651	0V	-85V	0V	-85V	0V	-35V	-85V			Volts
		45	∞	45	∞	45	∞	∞			Ohms
XV6	5651	-85V	-165V	-85V	-165V	-85V	-85V	-165V			Volts
		0	1.2 meg	∞	1.2 meg	∞	∞	1.2 meg			Ohms
XV7	5R4GY	0V	-850V	0V	-1850V	0V	-1850V	0V	-850V		Volts
		∞	∞	∞	1.1 meg	∞	1.1 meg	∞	∞		Ohms
XV8	6AR6	-1250V	0V	-750V	0V	-850V	FIL -1250V	-1350V	FIL -1250V		Volts
		1 meg	∞	∞	∞	∞	1 meg	1.3 meg	1 meg		Ohms

Notes:
1. Voltage readings taken with 20,000 ohm/volt vom between pin and chassis ground.
2. Resistance reading taken with electrical power cable assembly removed.
3. FIL = 6.3 vac between pins so marked.

(Cont'd)

TABLE 5-1. VOLTAGE AND RESISTANCE MEASUREMENTS, MSG-34 POWER SUPPLIES (Cont'd)

Socket	Tube Type	Pin Number 1	2	3	4	5	6	7	8	9	
XV9	12AT7	-1350V	-1400V	-1400V	FIL -1250V	FIL -1250V	-1350V	-1350V	-1350V	FIL -1250V	Volts
		1.3 meg	2.25 meg	1.2 meg	1.2 meg	1.2 meg	1.2 meg	1.4 meg	1.3 meg	1 meg	Ohms
XV10	5651	-1250V	-1350V	-1250V	-1350V	-1250V	-1250V	-1350V			Volts
		1 meg	1.2 meg	∞	1.3 meg	1 meg	∞	1.3 meg			Ohms
XV11	OA2	-1250V	-1400V	-1250V	-1400V	-1250V	-1250V	-1400V			Volts
		1 meg	1.3 meg	∞	1.3 meg	1 meg	∞	1.3 meg			Ohms
XV12	OA2	-1400V	-1550V	-1400V	-1550V	-1400V	-1400V	-1550V			Volts
		1.3 meg	1.2 meg	∞	1.2 meg	1.3 meg	∞	1.2 meg			Ohms
XV13	5Y3	0V	+385V	0V	-108V	0V	-108V	0V	+390V		Volts
		∞	∞	∞	4.5K	∞	4.5K	∞	∞		Ohms
XV14	6AR6	0V	0V	+385V	0V	+210V	FIL	-30V	FIL		Volts
		0	∞	∞	∞	.2 meg	0	.32 meg	0		Ohms
XV15	12AX7	+ 110V	0V	0V	FIL	FIL	+12.5V	0V	0V	FIL	Volts
		.25 meg	.7 meg	0	0	0	.65 meg	0	0	—	Ohms
XV16	OB2	0V	-22V	0V	-22V	0V	0V	-22V			Volts
		2.25 meg	4.5K	∞	4.5K	2.25 meg	∞	4.5K			Ohms

Notes: 1. Voltage readings taken with 20,000 ohm/volt vom between pin and chassis ground.

2. Resistance reading taken with electrical power cable assembly removed.

3. FIL = 6.3 vac between pins so marked.

(Cont'd)

TABLE 5-1. VOLTAGE AND RESISTANCE MEASUREMENTS, MSG-34 POWER SUPPLIES (Cont'd)

Socket	Tube Type	Pin Number 1	2	3	4	5	6	7	8	9	
XV17	5Y3	0V	+460V	0V	0V	0V	385AC	0V	+460V		Volts
		∞	1.55 meg	∞	65	∞	62	∞	1.55 meg		Ohms
XV18	6080	+34V	+460V	+210V	+33V	+460V	+210V	FIL	FIL		Volts
		0.5 meg	1.5 meg	0.2 meg	0.5 meg	1.5 meg	.2 meg	0	∞		Ohms
XV19	12AX7	+65V	0V	0V	FIL	FIL	152V	+60V	+65V	FIL	Volts
		0.5 meg	0.6 meg	0	0	0	260K	∞	65K	0	Ohms
XV20	OA2	+ 210V	+65V	+52V	+65V	+210V	+48V	+65V			Volts
		0.2 meg	6.5K	∞	6.5K	∞	∞	6.5K			Ohms

Notes:
1. Voltage readings taken with 20,000 ohm/volt vom between pin and chassis ground.
2. Resistance reading taken with electrical power cable assembly removed.
3. FIL = 6.3 vac between pins so marked.

TABLE 5-2. RF AND KEYER, VOLTAGE AND RESISTANCE MEASUREMENTS

Socket	Tube Type	Pin Number 1	2	3	4	5	6	7	8	9	
XV103	6X4	-1350V	0V	FIL -850V	FIL -850V	0V	-1350V	-900V			Volts
		1.3 meg	∞	∞	∞	∞	1.3 meg	5 meg			Ohms
XV104	6AR6	-1200V	0V	-925V	0V	-925V	FIL -850V	-1250V	FIL -850V		Volts
		1.2 meg	∞	5 meg	∞	5 meg	∞	1.3 meg	∞		Ohms
XV105	12AX7	-1250V	-1350V	-1350V	FIL -1350V	FIL -1350V	-1300V	-1350V	-1350V	FIL -1350V	Volts
		1.3 meg	2 meg	1.2 meg	1.2 meg	1.2 meg	1.6 meg	1.25 meg	1.2 meg	1.2 meg	Ohms
XV107	6AH6	-1400V	-135V	FIL -1350V	FIL -1350V	-1200V	-1200V	-1350V			Volts
		1.5 meg	1.3 meg	1.3 meg	1.3 meg	1.2 meg	1.2 meg	1.3 meg			Ohms
XV108	6CL6	-1350V	-1350V	-1200V	FIL -1350V	FIL -1350V	-1200V	-1350V	-1200V		Volts
		1.3 meg	1.3 meg	1.2 meg	1.3 meg	1.3 meg	1.3 meg	1.3 meg	1.3 meg		Ohms
XV102	ZV1011	-1250V	-1200V	FIL -1200V	FIL -1200V						Volts
		1.2 meg	1 meg	1 meg	1 meg						Ohms
XV101	6X4W	-1350V	-24V	FIL -1200V	FIL -1200V	-24V	-1350V	-1200V			Volts
		1.2 meg	∞	1 meg	1 meg	∞	1.2 meg	1 meg			Ohms

Notes: 1. Voltage readings taken with 20,000 ohm/volt vom between pins and chassis ground.

2. Resistance readings taken with electrical power cable assembly removed.

3. FIL = 6.3 vac between pins so marked.

TABLE 5-3. MODULATOR, VOLTAGE AND RESISTANCE MEASUREMENTS

Socket	Tube Type	Pin Number 1	2	3	4	5	6	7	8	9	
XV201	5725	-0.7V	0V	FIL	FIL	+150V	+125.5V	-8.5V			Volts
		.9 meg	0	0	0	.1 meg	30K	40K			Ohms
XV202	12AT7	+150V	-85V	0V	FIL	FIL	+115.5V	-49.5V	0V	FIL	Volts
		.165 meg	.55 meg	0	0	0	.57 meg	.48 meg	0	0	Ohms
XV203	5725	-2V	0V	FIL	FIL	+152V	+125V	-85.5V			Volts
		.85 meg	0	0	0	.14 meg	.68 meg	.55 meg			Ohms
XV204	12AT7	+210V	-27V	0V	FIL	FIL	+210V	175.5V	175.5V	FIL	Volts
		75K	20K	0	0	0	75K	85K	30K	0	Ohms
XV205	5725	+0.6V	0V	FIL	FIL	+175.5	+50.5V	-25.5V			Volts
		0.6 meg	0	0	0	8.5K	1.75K	20K			Ohms
XV206	5687	+210V	-24V	0V	FIL	FIL	FIL	-16V	0V	+210V	Volts
		7.5K	40K	500	0	0	80	6K	0	9K	Ohms
XV207	12AT7	+90.5V	+6.2V	0V	FIL	FIL	+ 90.5V	0V	0V	FIL	Volts
		11K	.85 meg	21.8K	0	0	15K	30K	110	0	Ohms
XV208	12AU7	+90.5V	+100V	0V	FIL	FIL	+90.5V	+100V	0V	FIL	Volts
		15K	30K	9K	0	0	20K	.97 meg	9K	0	Ohms

Notes:
1. Voltage readings taken with 20,000 ohms/volt vom between pins and chassis ground.
2. Resistance readings taken with electrical power cable assembly removed.
3. FIL = 6.3 vac between pins so marked.

(Cont'd)

TABLE 5-3. MODULATOR, VOLTAGE AND RESISTANCE MEASUREMENTS (Cont'd)

Socket	Tube Type	Pin Number 1	2	3	4	5	6	7	8	9	
XV209	5687	+210	-13V	0V	FIL	FIL	0V	-26V	FIL	+210	Volts
		9K	9K	0	0	0	90	10.5K	0	9K	Ohms
XV210	12AU7	+210V	0 V	+6.3V	FIL	FIL	+210V	0V	+6.3	FIL	Volts
		7.5K	3.2K	4.9K	0	0	7.5K	3.2K	4.9K		Ohms
XV211	6AN8	+210V	-22.8V	0 V	FIL	FIL	+80.8V	+80.2V	0 V	0 V	Volts
		.16 meg	.165 meg	0	0	0	.12 meg	.165 meg	800	0	Ohms
*XV212	6AH6	0 V	+4.8V	FIL	FIL +5.9V	+210V	+210V	+4.8V			Volts
		3 meg	1.1K	0	0	4.5K	4.5K	1.1K			Ohms

Notes: 1. Voltage readings taken with 20,000 ohms/volt vom between pins and chassis ground.

2. Resistance readings taken with electrical power cable assembly removed.

3. FIL = 6.3 vac between pins so marked.

* MODULATOR SELECTOR switch is set to CW or EXT MOD position.

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This parts list provides an alpha-numerical listing, in reference symbol sequence of the replaceable electrical, certain electro-mechanical, and mechanical parts of the equipment.

6-3. ORDERING INFORMATION. Orders for parts should contain the following information:

a. Equipment name and model.
b. Serial number.
c. Reference symbol of part.
d. Manufacturer's part number and code.

6-4. HOW TO USE THE PARTS LIST.

6-5. An explanation of the structure of the parts list, Table 6-2, and the meaning of the entries in the five columns are given in the following paragraphs. (See Figure 6-1.)

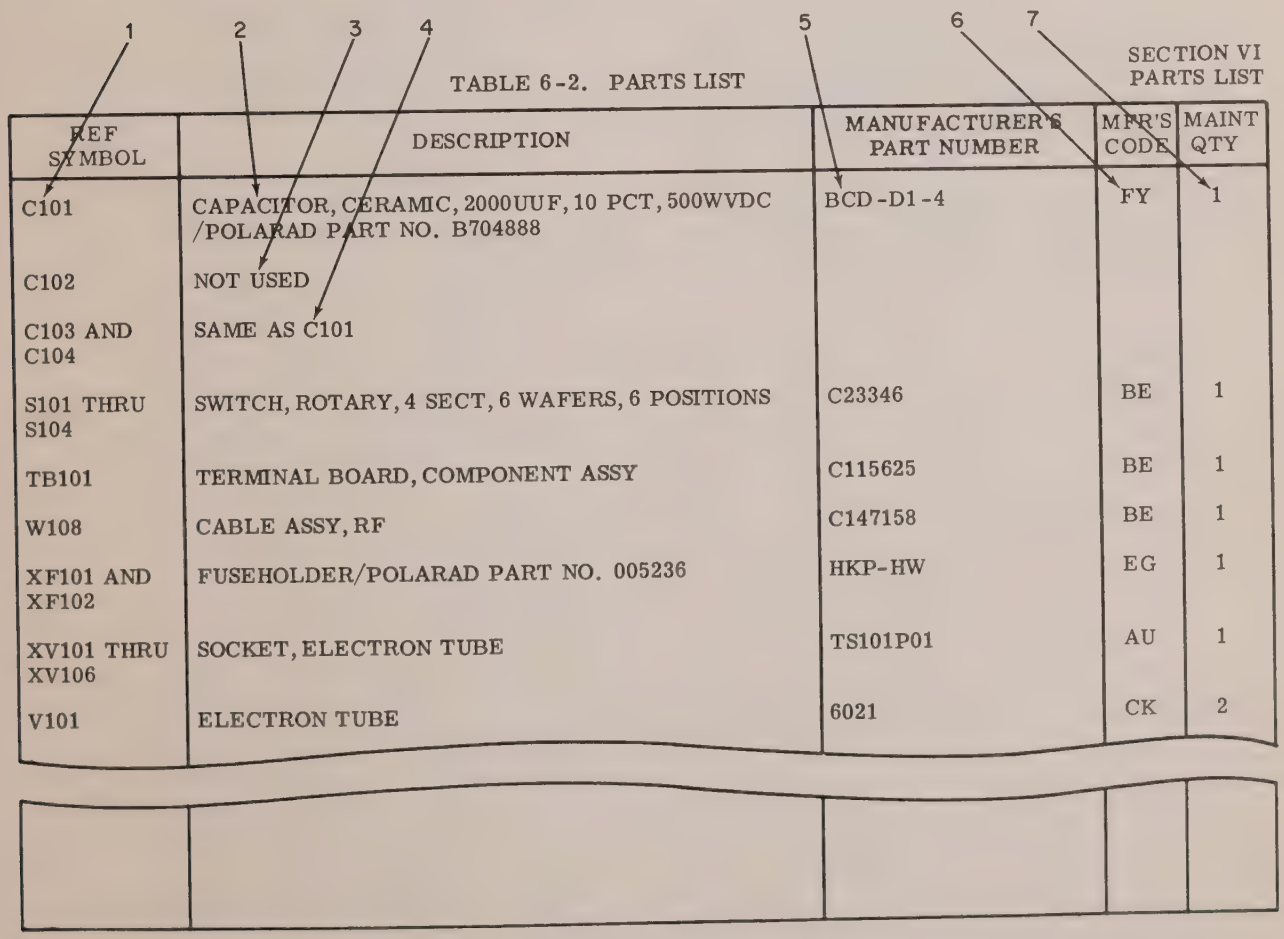


Figure 6-1. Parts List Example

6-6. REFERENCE SYMBOL COLUMN. The reference symbol column (1, Figure 6-1) contains the reference symbol assigned to each part, which also identifies the part on the schematic diagram or in an illustration. The listing is in alpha-numerical order.

6-7. DESCRIPTION COLUMN. The description column (2) contains the description for each part. When the same part is used more than once in the equipment, the second and subsequent listings for that part use the phrase "SAME AS ___" (4) in the description column and the remaining columns (5, 6, and 7) are left blank. When a reference symbol designation has not been used or its assignment has been cancelled, the description column contains the phrase "NOT USED" (3).

6-8. MANUFACTURER'S PART NUMBER COLUMN. The manufacturer's part number column (5) contains the part number assigned by the manufacturer of the part, except for "SAME AS ___" and "NOT USED" listings.

6-9. MANUFACTURER'S CODE COLUMN. The manufacturer's code column (6) contains a letter code identifying the manufacturer of the part. Table 6-1 contains a listing of the letter codes and the manufacturers names and addresses.

6-10. MAINTENANCE QUANTITY COLUMN. The maintenance quantity column (7) contains the recommended maintenance quantity for each part, based on a one year requirement for an equipment in operation or 10 hours a day throughout the year. The recommended maintenance quantities will provide a high degree of equipment reliability in areas where an adequate supply of replacement parts is not available. The recommended maintenance quantity is listed for the initial occurrence of the part in the parts list, but covers all subsequent listings.

6-11. To determine recommended maintenance quantity for periods other than one year, multiply the one-year quantity by the desired period, expressed in years.

6-12. To determine recommended maintenance quantity for operating periods other than 10 hours per day, use the equation given below.

$$MQ' = MQ \times \frac{HR_{op}}{10}$$

where: MQ = Maintenance quantity from Table 6-2

MQ' = Maintenance quantity for desired operating period

HR_{op} = Operating period in hours

Round off the quantity obtained to the nearest whole number.

TABLE 6-1. MANUFACTURER'S CODE

CODE	NAME AND ADDRESS
A	Aeronautical Standards Group, Dept. of Navy & Air Force, Washington, D.C.
B	Aerovox Corp., New Bedford, Mass.
C	Alden Products Co., Brockton, Mass.
D	Allen-Bradley Co., Milwaukee, Wis.
E	Amperite Co., New York, N.Y.
F	Amphenol Connector Division of Amphenol-Borg Electronics Corp., Chicago, Ill.
G	Belden Mfg. Co., Chicago, Ill.
H	Bendix Semiconductor Division of Bendix Corp., Holmdel, N.J.
J	Birnbach Radio Co., New York, N.Y.
K	Birtcher Corp., Los Angeles, Calif.
L	Boston Gear Works Division of Murray Co. of Texas, Boston, Mass.
M	Shallcross Mfg. Co., Selma, N.C.
N	Bourns Laboratories, Inc., Riverside, Calif.
P	Centralab Division of Globe-Union, Inc., Milwaukee, Wis.
Q	Chatam Electronics Division of Tung-Sol Electric, Inc., Livingston, N.J.
R	Cinch Mfg. Co., Division of United-Carr Fastener Corp., Chicago, Ill.
S	Clarostat Mfg. Co., Inc., Dover, N.H.
T	Condenser Products Co., Brooksville, Fla.
U	Cornell-Dubilier Electric Corp., Newark, N.J.
V	Dialight Corp., Brooklyn, N.Y.
W	Eby, S.E., Co., Philadelphia, Pa.
X	Elco Corp., Philadelphia, Pa.
Y	Erie Resistor Corp., Erie, Pa.
Z	General Electric Co., Miniature Lamp Department of Lamp Division of Consumer Products Group, Cleveland, Ohio
AA	General Electric Co., Semi-Conductor Products Department of Electronic Components Division of Electronic, Atomic and Defense Systems Group, Syracuse, N.Y.
AB	General Transistor Western Corp., Los Angeles, Calif.
AC	Good-All Electric Mfg. Co., Ogallala, Nebr.
AD	Hammarlund Co., Inc., New York, N.Y.
AE	Harvey Hubbell, Inc., Bridgeport, Conn.
AF	Helipot Division of Beckman Instruments,Inc., Fullerton, Calif.
AG	Hopkins Engineering Co., San Fernando, Calif.
AH	Hughes Products Division of Hughes Aircraft Co., Newport Beach, Calif.
AJ	International Resistance Co., Philadelphia, Pa.
AK	Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
AL	JBT Instruments Inc., New Haven, Conn.
AM	Kenyon Transformer Co., Inc., Jersey City, N.J.
AN	Kurman Electric Co., Inc., Brooklyn, N.Y.
AP	Littelfuse, Inc., Des Plaines, Ill.
AQ	Mallory Battery Co., North Tarrytown, N.Y.
AR	Metex Electronics Corporation, Clark, N. J.
AS	James Millen Mfg. Co., Inc., Malden, Mass.
AT	J.W. Miller Co., Los Angeles, Calif.
AU	Military Specifications
AV	Military Standards
AW	Minor Rubber Co., Inc., Bloomfield, N.J.
AX	Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.
AY	New Departure Division of General Motors Corp., Bristol, Conn.
AZ	Ohmite Mfg. Co., Skokie, Ill.
BA	Patton MacGuyer Co., Providence, R.I.
BB	Parker Kalon Division of General American Transportation Corp., Clifton, N.J.
BC	Pic Design Corp., East Rockaway, N.Y.

TABLE 6-1. MANUFACTURER'S CODE (CONT'D)

CODE	NAME AND ADDRESS
BD	Plastic Capacitors, Inc., Chicago, Ill.
BE	Polarad Electronics Corp., Long Island City, N.Y.
BF	Potter and Brumfield Division of American Machine and Foundry Co., Princeton, Ind.
BG	Pyramid Electric Co., Darlington, S.C.
BH	Raytheon Co., Industrial Components Division, Industrial Tube Operation, Newton, Mass.
BJ	RCA Semiconductor and Materials Division of Radio Corp. of America, Somerville, N.J.
BK	Ripley Co., Inc., Middletown, Conn.
BL	Sangamo Electric Co., Springfield, Ill.
BM	Shakeproof Division of Illinois Tool Works, Elgin, Ill.
BN	Sprague Electric Co., North Adams, Mass.
BP	Staver Co., Inc., Bay Shore, Long Island, N.Y.
BQ	Sterling Transformer Corp., Brooklyn, N.Y.
BR	Technitrol Engineering Co., Philadelphia, Pa.
BS	Telewave Laboratories, Inc., Long Island City, N.Y.
BT	Times Facsimile Corp., New York, N.Y.
BU	Transitron Electronic Corp., Wakefield, Mass.
BV	Ucinite Co., Newtonville, Mass.
BW	United Transformer Co., New York, N.Y.
BX	Utah Radio Products Corp., Huntington, Ind.
BY	Vector Mfg. Co., Houston, Tex.
BZ	Victory Engineering Corp., Springfield, N.J.
CA	Waldes Kohinoor, Inc., Long Island City, N.Y.
CB	Weckesser Co., Chicago, Ill.
CC	Winchester Electronics Co., Inc., Norwalk, Conn.
CD	Cutler-Hammer, Inc., Milwaukee, Wis.
CE	Olsen Machine and Tool Co., North Abington, Mass.
CF	Cannon Electric Co., Los Angeles, Calif.
CG	Arco Electronics, Inc., Great Neck, N.Y.
CH	Cambridge Thermionic Corp., Cambridge, Mass.
CJ	Sylvania Electric Products, Inc., Semiconductor Division, Woburn, Mass.
CK	Commercially Available Component
CL	Stackpole Carbon Co., St. Marys, Pa.
CM	Astron Co., East Newark, N.J.
CN	Sarkes Tarzian, Inc., Bloomington, Ind.
CP	Arrow Hart and Hegeman Electric Co., Hartford, Conn.
CQ	Radio Corp. of America, New York, N.Y.
CR	Allied Control Co., Inc., New York, N.Y.
CS	Sylvania Electric Products, Inc., New York, N.Y.
CT	Leach Corp., Leach Relay Co. Division, Los Angeles, Calif.
CU	Triplett Electrical Instrument Co., Bluffton, Ohio
CV	Bliley Electric Co., Inc., Erie, Pa.
CW	Switchcraft, Inc., Chicago, Ill.
CX	Industrial Products Co., Division of Amphenol-Borg Electronics Corp., Danbury, Conn.
CY	Mepco Division of Sessions Clock Co., Morristown, N.J.
CZ	Resistance Products Co., Harrisburg, Pa.
DA	Continental-Wirt Electronics Corp., Philadelphia, Pa.
DB	Ward Leonard Electric Co., Mount Vernon, N.Y.
DC	Superex Electronics Corp., Yonkers, N.Y.
DD	Oak Mfg. Co., Crystal Lake, Ill.
DE	National Radio Co., Inc., Malden, Mass.

TABLE 6-1. MANUFACTURER'S CODE (CONT'D)

CODE	NAME AND ADDRESS
DF	Wright Electronics, Inc., Kansas City, Mo.
DG	Torrington Mfg. Co., Torrington, Conn.
DH	Union Electronics, Long Island City, N.Y.
DJ	Applied Research, Inc., Port Washington, N.Y.
DK	Ferroxcube Corp. of America, Saugerties, N.Y.
DL	Technology Instrument Corp., Acton, Mass.
DM	Allen B. DuMont Laboratories, Inc., New York, N.Y.
DN	Amperex Electronic Co., Division of North American Philips Co., Inc., Hicksville, N.Y.
DP	Industrial Condenser Corp., Chicago, Ill.
DQ	International Rectifier Corp., El Segundo, Calif.
DR	CTS Corp., Elkhart, Ind.
DS	General Radio Co., West Concord, Mass.
DT	Microlab, Inc., Livingston, N.J.
DU	Comar Electric Co., Chicago, Ill.
DV	Film Capacitors, Inc., New York, N.Y.
DW	FXR Division of Amphenol-Borg Electronics Corp., Danbury, Conn.
DX	Britton Electronics Corp., Mount Vernon, N.Y.
DY	Chicago Standard Transformer Corp., Chicago, Ill.
DZ	P. R. Mallory and Co., Inc., Indianapolis, Ind.
EA	Automatic Metal Products Co., Brooklyn, N.Y.
EB	Dale Electronics, Inc., Columbus, Nebr.
EC	Gulton Industries, Inc., Metuchen, N.J.
ED	International Electronic Industries, Inc., Nashville, Tenn.
EE	Clairtron Mfg. Co., Orange, N.J.
EF	Technical Apparatus Builders, New York, N.Y.
EG	Bussmann Fuse Division of McGraw-Edison Co., St. Louis, Mo.
EH	The Superior Electric Co., Bristol, Conn.
EJ	Rotron Mfg. Co., Inc., Woodstock, N.Y.
EK	Jeffers Electronics Division of Speer Carbon Co., DuBois, Pa.
EL	JFD Electronics Corp., Brooklyn, N.Y.
EM	Essex Electronics Division of Nytronics Inc., Berkeley Heights, N.J.
EN	Torotel, Inc., Kansas City, Mo.
EP	Texas Instruments Inc., Dallas, Texas
EQ	Wells Electronics Co., South Bend, Ind.
ER	Thordarson-Meissner Division of Maguire Industries, Inc., Mount Carmel, Ill.
ES	Piezo Crystal Co., Carlisle, Pa.
ET	Pacific Semiconductors, Inc., Hawthorne, Calif.
EV	Fasco Industries, Inc., Rochester, N.Y.
EW	Triad Transformer Corp., Venice, Calif.
EX	National Tel Tronics Corp., Yonkers, N.Y.
EY	Carling Electric, Inc., Hartford, Conn.
EZ	E. F. Johnson Co., Waseca, Minn.
FA	Thomas Electronics, Inc., Passaic, N.J.
FB	Merit Coil and Transformer Corp., Hollywood, Fla.
FC	Aladdin Electronics Division of Aladdin Industries, Inc., Nashville, Tenn.
FD	Kulka Electric Corp., Mount Vernon, N. Y.
FE	Sperry Semiconductor Division of Sperry Rand Corp., Norwalk, Conn.
FF	Corning Glass Works, Electronic Components Department, Bradford, Pa.
FG	Duncan Electronics, Inc., Santa Ana, Calif.
FH	Advance Electronics Laboratories, Inc., Passaic, N.J.

TABLE 6-1. MANUFACTURER'S CODE (CONT'D)

CODE	NAME AND ADDRESS
FJ	Fastex Division of Illinois Tool Works, Des Plaines, Ill.
FK	Motorola, Inc., Semiconductor Products Division, Phoenix, Ariz.
FL	Electro Motive Mfg. Co., Willimantic, Conn.
FM	Varian Associates, Palo Alto, Calif.
FN	Quality Components, Inc., St. Marys, Pa.
FP	Automatic Mfg. Corp., Newark, N.J.
FQ	Electra Mfg. Co., Kansas City, Mo.
FR	Dage Electric Co., Inc., Beech Grove, Ind.
FS	The Cornish Wire Co., New York, N.Y.
FT	RLC Electronics, Inc., Mamaroneck, N.Y.
FU	Fairchild Camera and Instrument Corp., Semiconductor Division, Mountain View, Calif.
FV	Burnell and Co., Inc., Pelham Manor, N.Y.
FW	Dearborn Electronic Laboratories, Inc., Orlando, Fla.
FX	Weston Instruments, Division of Daystrom, Inc., Newark, N.J.
FY	HI-Q Division of Aerovox Corp., Myrtle Beach, S.C.
FZ	Electric Regulator Corp., South Norwalk, Conn.
GA	Simpson Electric Co., Chicago, Ill.
GB	Control Switch Division, Controls Co. of America, Chicago, Ill.
GC	Semicon, Inc., Bedford, Mass.
GD	Filtron Co., Inc., Flushing, Long Island, N.Y.
GE	Rotating Components, Inc., Brooklyn, N.Y.
GF	Transco Products, Inc., Los Angeles, Calif.
GG	Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
GH	PRD Electronics, Inc., Brooklyn, N.Y.
GJ	Solitron Devices, Inc., Norwood, N.J.
GK	Valpey Crystal Co., Holliston, Mass.
GL	Sage Laboratories, Inc., Natick, Mass.
GM	J.H. Williams and Co., Buffalo, N.Y.
GN	Kings Electronics Co., Inc., Tuckahoe, N.Y.
GP	ITT Federal Division of International Telephone and Telegraph Corp., Clifton, N.J.
GQ	Herman H. Smith, Inc., Brooklyn, N.Y.
GR	Leecraft Mfg. Co., Inc., New York, N.Y.
GS	Adel Division of General Metals Corp., Huntington, W. Va.
GT	Augat Bros., Inc., Attleboro, Mass.
GU	Master Specialties Co., Los Angeles, Calif.
GV	Radio Cores, Inc., Oak Lawn, Ill.
GW	Camloc Fastener Corp., Paramus, N. J.
GX	Zierick Mfg. Corp., New Rochelle, N. Y.
GY	Phelps Dodge Copper Products Corp., Inca Mfg. Division, Fort Wayne, Ind.
GZ	Tung-Sol Electric, Inc., Newark, N. J.
HA	General Ceramics Corp., Keasbey, N. J.
HB	Southco Division of South Chester Corp., Lester, Pa.
HC	Heyman Mfg. Co., Kenilworth, N. J.
HD	International Electronic Research Corp., Burbank, Calif.
HE	Technitrol Engineering Co., Philadelphia, Pa.
HF	Polyphase Instrument Co., Bridgeport, Montgomery County, Pa.
HG	General Electric Co., Receiving Tube Department of Electronic Components Division, Clifton, N. J.
HH	Alpha Wire Corp., New York, N. Y.
HJ	Metal Textile Corp., Roselle, N. J.
HK	Speer Resistor Division of Speer Carbon Co., Bradford, Pa.

TABLE 6-1. MANUFACTURER'S CODE (CONT'D)

CODE	NAME AND ADDRESS
HL	Curtiss-Wright Corp., Electronics Division, East Patterson, N. J.
HM	Mueller Electric Co., Cleveland, Ohio
HN	Bergen Laboratories, Patterson, N. J.
HP	Sherold Crystals, Inc., Kansas City, Mo.
HQ	Hewlett-Packard Co., Palo Alto, Calif.
HR	Keystone Electronics Corp., New York, N. Y.
HS	Hupp Electronics, Division of Hupp Corp., Forest Park, Ill.
HT	Continental Connector Corp., Division of De Jur Amsco Corp., Long Island City, N. Y.
HU	Arnold Stevens Co., Inc., Boston, Mass.
HV	Grant Pulley and Hardware Co., West Nyack, N. Y.
HW	Filmohm Corp., New York, N. Y.
HX	Freed Transformer Co., Brooklyn, N. Y.
HY	Trimm, Inc., Libertyville, Ill.
HZ	Minneapolis Honeywell Regulator Co., Precision Meter Division, Manchester, N. H.
JA	Edwin B. Stimpson Co., Inc., Brooklyn, N. Y.
JB	Burndy Corp., Norwalk, Conn.
JC	Bradley Industries, Chicago, Ill.
JD	Aemco, Inc., Mankato, Minn.
JE	Molon Motors and Coil Corp., Chicago, Ill.
JF	Beckman Instruments, Inc., Fullerton,Calif.
JG	National Lock Washer Co., Newark, N. J.
JH	Tinnerman Products, Inc., Cleveland, Ohio
JJ	General Instrument Corp., Semiconductor Division, Newark, N. J.
JK	Vector Electronic Co., Glendale, Calif.
JL	Western Electric Co., Inc., New York, N. Y.
JM	Amp, Inc., Harrisburg, Pa.
JN	G. C. Electronics Mfg. Co., Rockford, Ill.
JP	Redmond Co., Inc., Owosso, Mich.
JQ	Philadelphia Handle Co., Camden, N. J.
JR	Gremar Mfg. Co., Inc., Wakefield, Mass.
JS	Monadnock Mills, San Leandro, Calif.
JT	Instrument Specialties Co., Inc., Little Falls, N. J.
JU	Connecticut Hard Rubber Co., New Haven, Conn.
JV	Veeder Root, Inc., Hartford, Conn.
JW	Beemer Engineering Co., Philadelphia, Pa.
JX	Breeze Corporation, Inc., Union, N. J.
JY	Remler Co., Ltd., San Francisco, Calif.
JZ	TA Mfg. Corp., Los Angeles, Calif.
KA	Sigma Instruments, Inc., South Braintree, Mass.
KB	Standard Transformer Corp., Chicago, Ill.
KC	Thomson Industries, Inc., Long Island City, N. Y.
KD	United Electronics Co., Newark, N. J.
KE	U. S. Engineering Co., Long Island City, N. Y.

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
	MODEL MSG-34 MICROWAVE SIGNAL GENERATOR			
A1	POWER SUPPLY ASSY	D28813	BE	1
A2	FRONT PANEL ASSY	C28821	BE	1
A3	REPELLER AND BEAM CHASSIS ASSY	D28810	BE	1
A4	POWER CHASSIS ASSY	C28808	BE	1
A101	MODEL MSG-34 TUNING UNIT ASSY	E106136	BE	1
A102	OSCILLATOR ASSY	D106547	BE	1
A103	COMPONENT ASSY	B106321	BE	1
A104	COUNTER ASSY	A119351	BE	1
A105	POWER SUPPLY ASSY	D100287	BE	1
A106	THERMISTOR MOUNT ASSY	C134690	BE	1
A201	MODULATOR ASSY	D141586	BE	1
A202	REAR PANEL ASSY	D141420	BE	1
A203 AND A204	RESISTOR AND SWITCH ASSY	B141427	BE	1
B1	FAN ASSY,AXIAL,SYNCHRONOUS,115VAC,50-60CPS	C28807	BE	1
B1A	MOTOR,FAN,SYNCHRONOUS,115VAC,50-60CPS, PART OF B1	BK5565	BE	1
B1B	IMPELLER,FAN,AXIAL,CCW,HUB IN FRONT /POLARAD PART NO. 511504/PART OF B1	0-621-4-CCWF	DG	1
B1C	SPIDER,MOTOR MOUNTING,PART OF B1	B28724	BE	1
B2	BLOWER ASSY,CENTRIFUGAL,115VAC,50-60CPS	C113165	BE	1
B2A	MOTOR,FAN,CENTRIFUGAL,115VAC,50-60CPS, /POLARAD PART NO. C111581/PART OF B2	8438	BK	1
B2B	BRACKET ASSY,PART OF B2	C112776	BE	1
CR1	SEMICONDUCTOR DEVICE,RECTIFIER,GERMANIUM /POLARAD PART NO. A100211	4JA211AB1AA1.	AA	5
CR101 AND CR102	NOT USED			
CR103	SEMICONDUCTOR DEVICE,DIODE	1N198	CK	25
CR201 AND CR202	NOT USED			
CR203	SEMICONDUCTOR DEVICE,DIODE	1N625	CK	5
CR204	SEMICONDUCTOR DEVICE,DIODE	6008	AH	5
CR205 AND CR206	SAME AS CR103			
CR207 THRU CR210	NOT USED			
CR211 AND CR212	SAME AS CR103			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
CR213	SEMICONDUCTOR DEVICE,DIODE	1N69	CK	5
C1 AND C2	CAPACITOR,PAPER,2UF,20 PCT,1500WVDC	CP70B1FH205M	AU	1
C3	CAPACITOR,PAPER,0.05UF,20 PCT,300WVDC	CN42AX503M	AU	1
C4	CAPACITOR,PAPER,0.05UF,20 PCT,400WVDC	CN43AE503M	AU	1
C5	CAPACITOR,PAPER,0.25UF,20 PCT,1500WVDC	CP70B1FH254M	AU	1
C6	CAPACITOR,PAPER,1UF,20 PCT,1500WVDC	CP70B1FH105M	AU	1
C7	NOT USED			
C8	SAME AS C1			
C9	CAPACITOR,PAPER,0.25UF,20 PCT,600WVDC	CP29A1EF254M	AU	1
C10	CAPACITOR,MICA,5100UUF,20 PCT,500WVDC	CM35B512M	AU	1
C11	SAME AS C3			
C12	SAME AS C6			
C13	NOT USED			
C14 AND C15	CAPACITOR,PAPER,0.1UF,20 PCT,400WVDC	CN43EE104M	AU	1
C16	SAME AS C6			
C17	CAPACITOR,PAPER,2UF,20 PCT,400WVDC /POLARAD PART NO. B500725	MQLF-4-2M	CM	1
C18	CAPACITOR,MICA,0.01UF,20 PCT,300WVDC	CM35C103M	AU	1
C19	NOT USED			
C20	SAME AS C10			
C21	SAME AS C3			
C22	CAPACITOR,PAPER,2UF,20 PCT,200WVDC /POLARAD PART NO. B500626	MQLF-2-2M	CM	1
C23	CAPACITOR,ELECTROLYTIC,20UF,PLUS 85 PCT, MINUS 20 PCT,450WVDC/POLARAD PART NO. B708306	1735	B	1
C24	CAPACITOR,MICA,1000UUF,10 PCT,300WVDC	CM20B102K	AU	1
C25	SAME AS C3			
C26	NOT USED			
C27	CAPACITOR,PAPER,1UF,20 PCT,200WVDC	CP11A1EC105M	AU	1
C28	CAPACITOR,PAPER,4UF,20 PCT,400WVDC /POLARAD PART NO. B500921	MD-4-4M	CM	1
C29	NOT USED			
C30	CAPACITOR,ELECTROLYTIC,1200UUF,PLUS 150 PCT, MINUS 10 PCT,15WVDC	CE51C122E	AU	1
C101 AND C102	CAPACITOR,GLASS,0.1UF,10 PCT,2000WVDC /POLARAD PART NO. B703835	ASG104-2M	T	1
C103	CAPACITOR,PAPER,10UF,10 PCT,1000WVDC	CP70B1FG106K	AU	1

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
C104	CAPACITOR,PAPER,15000UUF,20 PCT,200WVDC	CP04A1EC153M	AU	1
C105	CAPACITOR,PAPER,0.22UF,20 PCT,200WVDC	CP04A1EC224M	AU	1
C106	CAPACITOR,PAPER,2UF,10 PCT,1000WVDC	CP41B1FG205K	AU	1
C107	NOT USED			
C108	CAPACITOR,GLASS,0.25UF,3000WVDC	0F30-254	BD	1
C109	NOT USED			
C110	CAPACITOR,MICA,100UUF,10 PCT,300WVDC	CM15B101K	AU	1
C111 THRU C113	NOT USED			
C114	CAPACITOR,GLASS,0.05UF,10 PCT,2000WVDC /POLARAD PART NO. B703834	ASG503-2M	T	1
C115	SAME AS C105			
C116	CAPACITOR,ELECTROLYTIC,20UF,50WVDC /POLARAD PART NO. B511256	PRS-20UF-50V	B	1
C201	CAPACITOR,MICA,5100UUF,2 PCT,500WVDC	CM35C512G	AU	1
C202	CAPACITOR,MICA,510UUF,2 PCT,300WVDC	CM15C511G	AU	1
C203	CAPACITOR,MICA,47UUF,2 PCT,300WVDC	CM15E470G	AU	1
C204	CAPACITOR,MICA,390UUF,10 PCT,300WVDC	CM15B391K	AU	1
C205 AND C206	CAPACITOR,MICA,33UUF,10 PCT,300WVDC	CM15B330K	AU	1
C207	SAME AS C201			
C208	SAME AS C202			
C209	SAME AS C203			
C210	NOT USED			
C211	CAPACITOR,MICA,100UUF,10 PCT,300WVDC	CM15C101K	AU	1
C212	CAPACITOR,MICA,43UUF,2 PCT,300WVDC	CM15E430G	AU	1
C213	SAME AS C202			
C214	SAME AS C201			
C215	CAPACITOR,MICA,75UUF,10 PCT,300WVDC	CM15B750K	AU	1
C216	CAPACITOR,CERAMIC,0.02UF,PLUS 60 PCT, MINUS 40 PCT,250WVDC/POLARAD PART NO. A702477	DDM-203	P	1
C217	SAME AS C205			
C218	CAPACITOR,PAPER,1UF,20 PCT,200WVDC /POLARAD PART NO. A702476	MQC-A-2	CM	1
C219	NOT USED			
C220	SAME AS C24			
C221	SAME AS C211			
C222	NOT USED			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
C223	CAPACITOR,MICA,0.01UF,10 PCT,300WVDC	CM35C103K	AU	1
C224 AND C225	NOT USED			
C226	SAME AS C14			
C227	CAPACITOR,PAPER,0.47UF,10 PCT,200WVDC	CP05A1EC474K	AU	1
C228	CAPACITOR,MICA,56UUF,10 PCT,300WVDC	CM15B560K	AU	1
C229	CAPACITOR,VARIABLE,CERAMIC,4-30UUF,500WVDC	CV11C300	AU	1
C230	CAPACITOR,MICA,120UUF,10 PCT,300WVDC	CM15B121K	AU	1
C231 AND C232	NOT USED			
C233	CAPACITOR,MICA,5600UUF,10 PCT,300WVDC /POLARAD PART NO. B703395	DM20F562K	FL	1
C234	SAME AS C223			
C235	SAME AS C202			
C236 AND C237	NOT USED			
C238	CAPACITOR,CERAMIC,0.1UF,PLUS 80 PCT, MINUS 20 PCT,500WVDC/POLARAD PART NO. A702290	41C92	BN	1
C239	NOT USED			
C240	CAPACITOR,MICA,4700UUF,10 PCT,500WVDC	CM35C472K	AU	1
C241	SAME AS C228			
C242	CAPACITOR,MICA,15UUF,10 PCT,300WVDC	CM15B150K	AU	1
C243	CAPACITOR,MICA,56UUF,2 PCT,500WVDC	CM15E560G	AU	1
C244	CAPACITOR,PLASTIC,0.22UF,10 PCT,400WVDC /POLARAD PART NO. B702715	663UW22494W2	AC	1
C245	CAPACITOR,MICA,3300UUF,10 PCT,500WVDC /POLARAD PART NO. B703387	DM20F332K	FL	1
C246	SAME AS C242			
C247	CAPACITOR,MICA,62UUF,10 PCT,300WVDC	CM15B620K	AU	1
DS1 AND DS2	LAMP,NEON,105-125VAC,BAYONET BASE /POLARAD PART NO. 005238	NE51	CK	4
F1 AND F2	FUSE,CARTRIDGE,5 AMP,3AG	F04A5R00A	AU	10
H1	KNOB/POLARAD PART NO. 517206	70-2-2	BH	1
H101	KNOB/POLARAD PART NO. 507301	125-6-2	BH	1
H102 AND H103	KNOB/POLARAD PART NO. 517207	90-2-2	BH	1
H201 AND H202	KNOB/POLARAD PART NO. A702510	70-8-2	BH	1
H203 AND H204	KNOB/POLARAD PART NO. A702475	231-1144G3	BH	1

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
H205 AND H206	KNOB/POLARAD PART NO. 517211	70-3-2	BH	1
H207 AND J208	KNOB	B115403	BE	1
J1	CONNECTOR,RECEPTACLE,FEMALE,24 PINS /POLARAD PART NO. B708333	QRE-24S	CC	1
J2	CONNECTOR,RECEPTACLE,MALE,14 PINS /POLARAD PART NO. 516105	MRE-14P-G	CC	1
J3	CONNECTOR,RECEPTACLE,FEMALE,26 PINS /POLARAD PART NO. B701015	MRE-26S-G	CC	1
J4	CONNECTOR,RECEPTACLE,FEMALE,34 PINS /POLARAD PART NO. B708343	RE-34S	CC	1
J5	CONNECTOR,RECEPTACLE,MALE,3 PINS /POLARAD PART NO. AK50123	91-MPM3S	F	1
J6	CONNECTOR,RECEPTACLE,POLARIZED,MALE,3 PINS /POLARAD PART NO. A700010	7486	AE	1
J101	CONNECTOR,RECEPTACLE,FEMALE, NON-REPLACEABLE PART OF W101			
J102	CONNECTOR,RECEPTACLE,FEMALE,BNC TYPE	UG-625/U	AU	1
J103	CONNECTOR,RECEPTACLE,FEMALE,BNC TYPE	UG-910/U	AU	1
J104	NOT USED			
J105 AND J106	JACK,BLACK/POLARAD PART NO. 541403	110BCS-BLACK	C	1
J107	SAME AS J202			
J201	NOT USED			
J202 THRU J205	CONNECTOR,RECEPTACLE,FEMALE,BNC TYPE	UG-909/U	AU	1
K1	RELAY,THERMAL DELAY,SPST,115VAC	115N075T	E	1
K2	RELAY,ARMATURE,DPDT	B16431	BE	1
K101 AND K102	RELAY,ARMATURE,DPDT,115V	26	AN	1
L101 AND L102	COIL,RF,VARIABLE,35-60UH	4509	AT	1
L201	COIL,RF,5MH	6304	AT	1
MP101	KLYSTRON COVER AND SOCKET ASSY	B106461	BE	1
M1	METER,0-200UA,2 PCT,DC	A101275	BE	1
M101	COUNTER/MODIFIED JV PART NO. BR137014	A113438	BE	1
P1	CONNECTOR,PLUG,MALE,24 PINS /POLARAD PART NO. B708334	QRE-24P	CC	1
P2	CONNECTOR,PLUG,FEMALE,14 PINS, WITH HOOD MRE-14H/POLARAD PART NO. 516104	MRE-14S-G	CC	1
P3	CONNECTOR,PLUG,MALE,26 PINS,WITH HOOD MRE26H /POLARAD PART NO. B701016	MRE-26P-G	CC	1

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
P4	CONNECTOR,PLUG,MALE,24 PINS, WITH HOOD QRE24H-1/POLARAD PART NO. B702809	RE-24P	CC	1
P5	CONNECTOR,RECEPTACLE,FEMALE,3 PINS /POLARAD PART NO. AK50124	91-MPF3S	F	1
P101	NOT USED			
P102	CONNECTOR,PLUG,MALE,BNC TYPE	UG-88C/U	AU	1
P103	CONNECTOR,PLUG,MALE,BNC TYPE	UG-260/U	AU	1
P104 THRU P106	NOT USED			
P107	SAME AS P103			
RT101	THERMISTER,NON-REPLACEABLE PART OF W102			
RT102	THERMISTER,725 OHMS,5 PCT /MODIFIED BZ PART NO. 2701	A700188	BF	1
RT103	THERMISTER,760 OHMS,5 PCT,10MW PER DEGREE CENTIGRADE/POLARAD PART NO. A700189	28D3	BZ	1
R1	RESISTOR,COMPOSITION,150K,10 PCT,1/2W	RC20GF154K	AU	1
R2	RESISTOR,COMPOSITION,100 OHMS,10 PCT,1/2W	RC20GF101K	AU	2
R3	RESISTOR,COMPOSITION,330K,10 PCT,1/2W	RC20GF334K	AU	1
R4	RESISTOR,COMPOSITION,68K,10 PCT,1/2W	RC20GF683K	AU	1
R5	RESISTOR,COMPOSITION,51 OHMS,5 PCT,1/2W	RC20GF510J	AU	1
R6	NOT USED			
R7	RESISTOR,COMPOSITION,100K,10 PCT,1/2W	RC20GF104K	AU	1
R8	RESISTOR,VARIABLE,COMPOSITION,100K,10 PCT,2W /POLARAD PART NO. 517934	RV4NAYSG104A	AU	1
R9 THRU R11	RESISTOR,COMPOSITION,330K,10 PCT,1W	RC32GF334K	AU	1
R12 AND R13	NOT USED			
R14 THRU R20	RESISTOR,COMPOSITION,39K,10 PCT,2W	RC42GF393K	AU	1
R21	RESISTOR,COMPOSITION,470K,10 PCT,1/2W	RC20GF474K	AU	1
R22	NOT USED			
R23	RESISTOR,COMPOSITION,3.9 MEGO,10 PCT,1/2W	RC20GF395K	AU	1
R24	RESISTOR,COMPOSITION,100K,10 PCT,2W	RC42GF104K	AU	1
R25	SAME AS R2			
R26	SAME AS R21			
R27	SAME AS R1			
R28	SAME AS R21			
R29	RESISTOR,COMPOSITION,8.2K,10 PCT,1W	RC32GF822K	AU	1
R30	SAME AS R7			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R31	RESISTOR,VARIABLE,COMPOSITION,100K,10 PCT,2W /POLARAD PART NO. 517912	RV4NAYSB104A	AU	1
R32	RESISTOR,COMPOSITION,820K,10 PCT,1/2W	RC20GF824K	AU	1
R33	RESISTOR,COMPOSITION,22K,10 PCT,2W	RC42GF223K	AU	1
R34 AND R35	SAME AS R24			
R36	RESISTOR,FILM,5.6 MEGO,1 PCT,1/2W /POLARAD PART NO. B708370	CPLX1/2-5.6MEG	B	1
R37	NOT USED			
R38 AND R39	RESISTOR,COMPOSITION,47K,10 PCT,2W	RC42GF473K	AU	1
R40	RESISTOR,COMPOSITION,470K,10 PCT,1/2W	RC20GF475K	AU	1
R41	SAME AS R2			
R42	RESISTOR,COMPOSITION,910K,5 PCT,1/2W	RC20GF914J	AU	1
R43	SAME AS R4			
R44	RESISTOR,COMPOSITION,270 OHMS,10 PCT,2W	RC42GF271K	AU	1
R45	RESISTOR,COMPOSITION,2.2 MEGO,10 PCT,1/2W	RC20GF225K	AU	1
R46	RESISTOR,COMPOSITION,220K,10 PCT,1/2W	RC20GF224K	AU	1
R47	RESISTOR,COMPOSITION,680K,10 PCT,1/2W	RC20GF684K	AU	1
R48	RESISTOR,COMPOSITION,27K,10 PCT,2W	RC42GF273K	AU	1
R49	RESISTOR,WW,1.5K,5 PCT,10W	456E1525	BN	1
R50	RESISTOR,VARIABLE,WW,5K,10 PCT,4W	RA30A2SD502AK	AU	1
R51	RESISTOR,VARIABLE,COMPOSITION,1K,10 PCT,2W	B530825	BE	1
R52	NOT USED			
R53 AND R54	RESISTOR,COMPOSITION,47 OHMS,10 PCT,2W	RC42GF470K	AU	1
R55	SAME AS R2			
R56	SAME AS R3			
R57	RESISTOR,COMPOSITION,1.5 MEGO,10 PCT,1/2W	RC20GF155K	AU	1
R58	RESISTOR,COMPOSITION,1 MEGO,10 PCT,1/2W	RC20GF105K	AU	1
R59	SAME AS R40			
R60	SAME AS R4			
R61	RESISTOR,COMPOSITION,6.8K,10 PCT,2W	RC42GF682K	AU	1
R62	RESISTOR,COMPOSITION,180K,10 PCT,1/2W	RC20GF184K	AU	1
R63	RESISTOR,VARIABLE,COMPOSITION,50K,10 PCT,2W /POLARAD PART NO. 517853	RV4NAYSD503A	AU	1
R64	RESISTOR,COMPOSITION,82K,10 PCT,1/2W	RC20GF823K	AU	1
R65	RESISTOR,WW,3 OHMS,5 PCT,1W	RU4B300J	AU	1

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R66	RESISTOR,COMPOSITION,15K,10 PCT,2W	RC42GF153K	AU	1
R67	SAME AS R65			
R68	NOT USED			
R69	RESISTOR,WW,4K,5 PCT,25W,WITH BRACKET NO. 9 /POLARAD PART NO. A703266	0211	AZ	1
R101	RESISTOR,VARIABLE,WW,100K,1 PCT,12W, TAP A,80K,TAP B,60K,TAP C,40K,TAP D,20K /POLARAD PART NO. C17230	RVLL-3-12-S	DL	1
R102	RESISTOR,VARIABLE,COMPOSITION,25K,10 PCT,2W /POLARAD PART NO. 517851	RV4NAYSD253A	AU	1
R103	SAME AS R63			
R104	NOT USED			
R105 AND R106	RESISTOR,VARIABLE,COMPOSITION,250K,10 PCT,2W /POLARAD PART NO. 517925	RV4NAYSD254A	AU	1
R107 AND R108	RESISTOR,VARIABLE,COMPOSITION,100K,10 PCT,2W /POLARAD PART NO. 517923	RV4NAYSD104A	AU	1
R109	RESISTOR,COMPOSITION,33K,10 PCT,2W	RC42GF333K	AU	1
R110	NOT USED			
R111	RESISTOR,COMPOSITION,220K,10 PCT,1W	RC32GF224K	AU	1
R112	SAME AS R45			
R113	RESISTOR,COMPOSITION,62 OHMS,5 PCT,1W	RC32GF620J	AU	1
R114	RESISTOR,COMPOSITION,820 OHMS,10 PCT,2W	RC42GF821K	AU	1
R115 AND R116	RESISTOR,FILM,250 OHMS,1 PCT,1/2W	RN20B2500F	AU	1
R117	RESISTOR,COMPOSITION,220 OHMS,10 PCT,1/2W	RC20GF221K	AU	1
R118	SAME AS R115			
R119	RESISTOR,FILM,130 OHMS,1 PCT,1/2W	RN20B1300F	AU	1
R120	NOT USED			
R121	SAME AS R2			
R122	SAME AS R64			
R123	RESISTOR,COMPOSITION,1.2 MEGO,10 PCT,1/2W	RC20GF125K	AU	1
R124	SAME AS R40			
R125	RESISTOR,COMPOSITION,820 OHMS,10 PCT,1/2W	RC20GF821K	AU	1
R126	SAME AS R7			
R127	RESISTOR,VARIABLE,COMPOSITION,10K,10 PCT,2W /POLARAD PART NO. 517831	RV4NAYSB103A	AU	1
R128	RESISTOR,COMPOSITION,91K,10 PCT,1/2W	RC20GF913K	AU	1
R129 AND R130	NOT USED			
R131	SAME AS R105			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R132	SAME AS R7			
R133 THRU R142	NOT USED			
R143	RESISTOR,COMPOSITION,56K,10 PCT,1/2W	RC20GF563K	AU	1
R144	SAME AS R58			
R145	SAME AS R40			
R146	RESISTOR,COMPOSITION,270K,10 PCT,1/2W	RC20GF274K	AU	1
R147	RESISTOR,COMPOSITION,10K,10 PCT,1/2W	RC20GF103K	AU	1
R148	SAME AS R58			
R149	RESISTOR,COMPOSITION,560K,10 PCT,1/2W	RC20GF564K	AU	1
R150	RESISTOR,FILM,50 OHMS,5 PCT,1/2W	A107833	BE	1
R151 THRU R153	NOT USED			
R154	SAME AS R45			
R155 THRU R157	NOT USED			
R158	RESISTOR,COMPOSITION,1.2K,10 PCT,2W	RC42GF122K	AU	1
R159	NOT USED			
R160	SAME AS R21			
R161	NOT USED			
R162	SAME AS R2			
R163	RESISTOR,COMPOSITION,10 OHMS,10 PCT,1/2W	RC20GF100K	AU	1
R164	RESISTOR,COMPOSITION,750 OHMS,10 PCT,2W	RC42GF751K	AU	1
R165	RESISTOR,COMPOSITION,36 OHMS,5 PCT,1/2W	RC20GF360J	AU	1
R166 AND R167	SAME AS R66			
R168 AND R169	NOT USED			
R170	SAME AS R33			
R171 AND R172	SAME AS R38			
R201	SAME AS R63			
R202	RESISTOR,FILM,750K,1 PCT,1/2W	CPX1/2-750K	B	1
R203	RESISTOR,COMPOSITION,51K,5 PCT,1/2W	RC20GF513J	AU	1
R204	RESISTOR,COMPOSITION,15K,10 PCT,1/2W	RC20GF153K	AU	1
R205	SAME AS R64			
R206	RESISTOR,COMPOSITION,2.2K,10 PCT,1/2W	RC20GF222K	AU	1
R207	RESISTOR,COMPOSITION,120K,10 PCT,1/2W	RC20GF124K	AU	1

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R208	RESISTOR,COMPOSITION,22K,5 PCT,2W	RC42GF223J	AU	1
R209	RESISTOR,COMPOSITION,47K,10 PCT,1W	RC32GF473K	AU	1
R210	SAME AS R2			
R211	RESISTOR,VARIABLE,COMPOSITION,500K,10 PCT, 1/4W	FA1N032S504UA	D	1
R212	RESISTOR,VARIABLE,WW,20K,5 PCT,5,8W	972P	DS	1
R213	RESISTOR,COMPOSITION,33K,10 PCT,1/2W	RC20GF333K	AU	1
R214 AND R215	SAME AS R208			
R216	SAME AS R2			
R217	RESISTOR,VARIABLE,WW,2K,10 PCT,1/4W /POLARAD PART NO, B702465	200S-1-202	N	1
R218	SAME AS R207			
R219	SAME AS R64			
R220	SAME AS R7			
R221	SAME AS R202			
R222	NOT USED			
R223	SAME AS R2			
R224	SAME AS R209			
R225	RESISTOR,FILM,680K,1 PCT,1/2W	CPX1/2-680K	B	1
R226	RESISTOR,COMPOSITION,18K,10 PCT,2W	RC42GF183K	AU	1
R227	SAME AS R7			
R228	SAME AS R207			
R229	SAME AS R64			
R230	RESISTOR,COMPOSITION,1,8K,10 PCT,1/2W	RC20GF182K	AU	1
R231	NOT USED			
R232	RESISTOR,COMPOSITION,8,2K,10 PCT,1/2W	RC20GF822K	AU	1
R233	RESISTOR,VARIABLE,WW,10K,10 PCT,1/4W /POLARAD PART NO, B700803	200S-1-103	N	1
R234	SAME AS R212			
R235	SAME AS R2			
R236	NOT USED			
R237	SAME AS R146			
R238	RESISTOR,VARIABLE,COMPOSITION,50K,10 PCT,1/4W	FA1N032S503UA	D	1
R239 THRU R241	NOT USED			
R242	RESISTOR,COMPOSITION,510 OHMS,5 PCT,1/2W	RC20GF511J	AU	1
R243	SAME AS R2			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R244	RESISTOR,COMPOSITION,47K,5 PCT,1/2W	RC20GF473J	AU	1
R245	RESISTOR,COMPOSITION,1K,10 PCT,1/2W	RC20GF102K	AU	1
R246	RESISTOR,COMPOSITION,8.2K,5 PCT,1/2W	RC20GF822J	AU	1
R247	RESISTOR,COMPOSITION,2.2K,10 PCT,1W	RC32GF222K	AU	1
R248	SAME AS R2			
R249 THRU R252	NOT USED			
R253	SAME AS R7			
R254	SAME AS R58			
R255	SAME AS R2			
R256	RESISTOR,COMPOSITION,4.7K,10 PCT,1/2W	RC20GF472K	AU	1
R257	SAME AS R247			
R258 THRU R260	NOT USED			
R261	RESISTOR,COMPOSITION,47K,10 PCT,1/2W	RC20GF473K	AU	1
R262	NOT USED			
R263	SAME AS R2			
R264	RESISTOR,COMPOSITION,12K,5 PCT,2W	RC42GF123J	AU	1
R265	RESISTOR,COMPOSITION,91K,5 PCT,1/2W	RC20GF913J	AU	1
R266	RESISTOR,COMPOSITION,120 OHMS,10 PCT,1/2W	RC20GF121K	AU	1
R267	RESISTOR,COMPOSITION,150K,5 PCT,1W	RC32GF154J	AU	1
R268	NOT USED			
R269	SAME AS R2			
R270	RESISTOR,COMPOSITION,11K,5 PCT,1W	RC32GF113J	AU	1
R271	NOT USED			
R272	SAME AS R62			
R273	SAME AS R147			
R274	SAME AS R46			
R275	SAME AS R2			
R276	RESISTOR,VARIABLE,WW,20K,10 PCT,1/4W /POLARAD PART NO. B702466	200S-1-203	N	1
R277	RESISTOR,COMPOSITION,12K,10 PCT,2W	RC42GF123K	AU	1
R278 AND R279	NOT USED			
R280	SAME AS R2			
R281	RESISTOR,COMPOSITION,75K,5 PCT,1/2W	RC20GF753J	AU	1
R282 AND R283	NOT USED			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R284	SAME AS R261			
R285	SAME AS R256			
R286	NOT USED			
R287	SAME AS R204			
R288 AND R289	SAME AS R2			
R290	SAME AS R247			
R291 AND R292	NOT USED			
R293	SAME AS R46			
R294	NOT USED			
R295	SAME AS R261			
R296	NOT USED			
R297	RESISTOR,COMPOSITION,510 OHMS,10 PCT,1W	RC32GF511K	AU	1
R300	RESISTOR,COMPOSITION,10K,10 PCT,1W	RC32GF103K	AU	1
R301 THRU R304	NOT USED			
R305	SAME AS R47			
R306	NOT USED			
R307	SAME AS R261			
R308	SAME AS R46			
R309	RESISTOR,VARIABLE,COMPOSITION,100K,10 PCT,1/4W	FA1N032S104UA	D	1
R310	SAME AS R29			
R311	NOT USED			
R312	SAME AS R143			
R313	RESISTOR,COMPOSITION,1K,10 PCT,2W	RC42GF102K	AU	1
R314	RESISTOR,WW,5K,5 PCT,5W /POLARAD PART NO. A702474	246E5025	BN	1
R315	RESISTOR,VARIABLE,WW,5K,10 PCT,1/4W /POLARAD PART NO. B700802	200S-1-502	N	1
R316	SAME AS R63			
R317	SAME AS R213			
R318	SAME AS R2			
R319	SAME AS R40			
R320	RESISTOR,COMPOSITION,330 OHMS,10 PCT,1/2W	RC20GF331K	AU	1
R321 AND R322	SAME AS R125			
R323	SAME AS R300			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
R324	RESISTOR•COMPOSITION•3•3K•10 PCT•1W	RC32GF332K	AU	1
S1	SWITCH•TOGGLE•DPDT/POLARAD PART NO• A126304	ST22N	AU	1
S2	SWITCH•ROTARY•6 POLES•2 POSITIONS /POLARAD PART NO• A137213	MS20-1-6DT	AL	1
S101 AND S102	SWITCH•SENSITIVE•SPDT/POLARAD PART NO• A20438	V3-13	AX	1
S201	SWITCH•ROTARY•3 SECT•6 WAFERS•5 POSITIONS /MODIFIED P PART NO• PA2029	B705917	BE	1
S202	SWITCH•ROTARY•1 SECT•2 WAFERS•3 POSITIONS /MODIFIED P PART NO• 037	B141587	BE	1
S203	SWITCH•ROTARY•4 SECT•6 WAFERS•6 POSITIONS	PA2027	P	1
S204	SAME AS S202			
TB1	TERMINAL BOARD•COMPONENT ASSY	C28806	BE	1
TB2	TERMINAL BOARD•COMPONENT ASSY	B28805	BE	1
TB3	TERMINAL BOARD•COMPONENT ASSY	B28804	BE	1
TB101	TERMINAL BOARD	B112283	BE	1
TB102	TERMINAL BOARD•COMPONENT ASSY	B100285	BE	1
TB103	TERMINAL BOARD•COMPONENT ASSY	B100266	BE	1
TB104	TERMINAL BOARD•COMPONENT ASSY	B101536	BE	1
TB105	TERMINAL BOARD/POLARAD PART NO• A106196	5-140-3/4W	R	1
TB201	TERMINAL BOARD•COMPONENT ASSY	D141414	BE	1
T1	TRANSFORMER•POWER/POLARAD PART NO• B100505	ST2529	BQ	1
T2	TRANSFORMER•POWER/POLARAD PART NO• B26680	ST2530	BQ	1
T3	TRANSFORMER•POWER/POLARAD PART NO• B108994	ST2521	BQ	1
T101	TRANSFORMER•POWER	B28087	BE	1
T201 AND T202	TRANSFORMER•PULSE	5Z107	BN	1
T203 AND T204	NOT USED			
T205	TRANSFORMER•PULSE	M02GA	HE	1
T206	TRANSFORMER•POWER•STEP-UP /POLARAD PART NO• B140494	ST3810	BQ	1
V1 AND V2	ELECTRON TUBE	5R4GY	CK	6
V3	ELECTRON TUBE	5933	CK	2
V4	ELECTRON TUBE	12AX7	CK	8
V5 AND V6	ELECTRON TUBE	5651	CK	6
V7	SAME AS V1			
V8	ELECTRON TUBE	6AR6	CK	6

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
V9	ELECTRON TUBE	12AT7	CK	8
V10	SAME AS V5			
V11 AND V12	ELECTRON TUBE	0A2	CK	6
V13	ELECTRON TUBE	5Y3	CK	4
V14	SAME AS V8			
V15	SAME AS V4			
V16	ELECTRON TUBE	0B2	CK	2
V17	SAME AS V13			
V18	ELECTRON TUBE	6080	CK	2
V19	SAME AS V4			
V20	SAME AS V11			
V101	ELECTRON TUBE	6X4	CK	4
V102	ELECTRON TUBE•KLYSTRON•4000-11000MC	ZV1011/8052	BE	1
V103	SAME AS V101			
V104	SAME AS V8			
V105	SAME AS V4			
V106	NOT USED			
V107	ELECTRON TUBE	6AH6	CK	4
V108	ELECTRON TUBE	6CL6	CK	2
V201	ELECTRON TUBE	5725	CK	6
V202	SAME AS V9			
V203	SAME AS V201			
V204	SAME AS V9			
V205	SAME AS V201			
V206	ELECTRON TUBE	5687	CK	4
V207	SAME AS V9			
V208	ELECTRON TUBE	12AU7	CK	4
V209	SAME AS V206			
V210	SAME AS V208			
V211	ELECTRON TUBE	6AN8	CK	2
V212	SAME AS V107			
W101	CABLE AND PROBE ASSY	B106681	BE	1
W102	CABLE AND PROBE ASSY	B106680	BE	1
W103	CABLE ASSY	C503335	BE	1
XDS1	LAMPHOLDER•BAYONET BASE•YELLOW /POLARAD PART NO. 524102	95410-936	V	1

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
XDS2	LAMPHOLDER,BAYONET BASE,WHITE /POLARAD PART NO. 524103	95410-935	V	1
XF1 AND XF2	FUSEHOLDER,EXTRACTOR POST,TYPE,3AG /POLARAD PART NO. 545300	340067	AP	1
XK1	SOCKET,RELAY	TS103P01	AU	1
XV1 AND XV2	SOCKET,ELECTRON TUBE/POLARAD PART NO. 506729	49-SS8	F	1
XV3	SOCKET,ELECTRON TUBE/POLARAD PART NO. 506725	49-SS5	F	1
XV4	SAME AS XK1			
XV5 AND XV6	SOCKET,ELECTRON TUBE	TS102P01	AU	1
XV7 AND XV8	SAME AS XV1			
XV9	SOCKET,ELECTRON TUBE/POLARAD PART NO. 506711	78-A9P	F	1
XV10 THRU XV12	SOCKET,ELECTRON TUBE/POLARAD PART NO. 506710	78-A7P	F	1
XV13 AND XV14	SOCKET,ELECTRON TUBE/POLARAD PART NO. 506718	78-S8T	F	1
XV15	SAME AS XK1			
XV16	SAME AS XV5			
XV17 AND XV18	SAME AS XV13			
XV19	SAME AS XK1			
XV20	SAME AS XV5			
XV101	SAME AS XV10			
XV102	NOT USED			
XV103	SAME AS XV10			
XV104	SOCKET,ELECTRON TUBE/POLARAD PART NO. 506706	78-S8	F	1
XV105	SAME AS XV9			
XV106	NOT USED			
XV107	SAME AS XV5			
XV108	SAME AS XK1			
XV201	SOCKET,ELECTRON TUBE/POLARAD PART NO. AK50019	9799-21	W	1
XV202	SOCKET,ELECTRON TUBE/POLARAD PART NO. AK50020	9799-22	W	1
XV203	SAME AS XV201			
XV204	SAME AS XV202			
XV205	SAME AS XV201			
XV206	SAME AS XV202			
XV207 THRU XV211	SAME AS XV202			
XV212	SAME AS XV201			

TABLE 6-2. PARTS LIST (CONT'D)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	MAINT QTY
	SUPPLIED ACCESSORIES			
A5	WRENCH KIT	A27109	BE	1
CP1	CONNECTOR,ADAPTER,3 TO 2 PINS,BLACK /POLARAD PART NO. A131966	228-BLK	FS	1
MP1	WRENCH,KLYSTRON	B144525	BE	1
MP2	WRENCH,SPANNER	A15550	BE	1
MP3	WRENCH,SPLINE	515101	BE	1
MP4	WRENCH,SPLINE	515102	BE	1
MP5	WRENCH,SPLINE	515103	BE	1
MP6	WRENCH,SPLINE	515104	BE	1
MP7	WRENCH,ALLEN	515301	BE	1
MP8	WRENCH,ALLEN	515302	BE	1
MP9	WRENCH,ALLEN	515303	BE	1
MP10	WRENCH,ALLEN	515304	BE	1
P6 AND P7	CONNECTOR,PLUG,MALE,N TYPE	UG-21D/U	AU	1
P8 AND P9	CONNECTOR,PLUG,MALE,BNC TYPE	UG-88/U	AU	1
P10	CONNECTOR,PLUG,POLARIZED,FEMALE,3 PINS /POLARAD PART NO. A700008	7484	AE	1
P11	CONNECTOR,PLUG,MALE,3 PINS, NON-REPLACEABLE PART OF W1A			
W1	CABLE ASSY,POWER	B145871	BE	1
W1A	CABLE ASSY,POWER,WITH MOULDED PLUG, PART OF W1	B701763	BE	1
W2	CABLE ASSY,RF	B12551	BE	1
W3	CABLE ASSY,VIDEO	B12553	BE	1

ADDENDUM

This addendum itemizes the differences that exist between Model MSG-34 Microwave Signal Generators Serial Nos. 8-1 and up* and Serial Nos. 141, 171, 184, 193, 227, 231, 240, 247, 278, 281 through 284, 292 through 299, 300, 301, 302, 306, 308, 311, 312, 315, 318, 320, 323, 324, 326, 330, 335 through 345, and 347 through 369**.

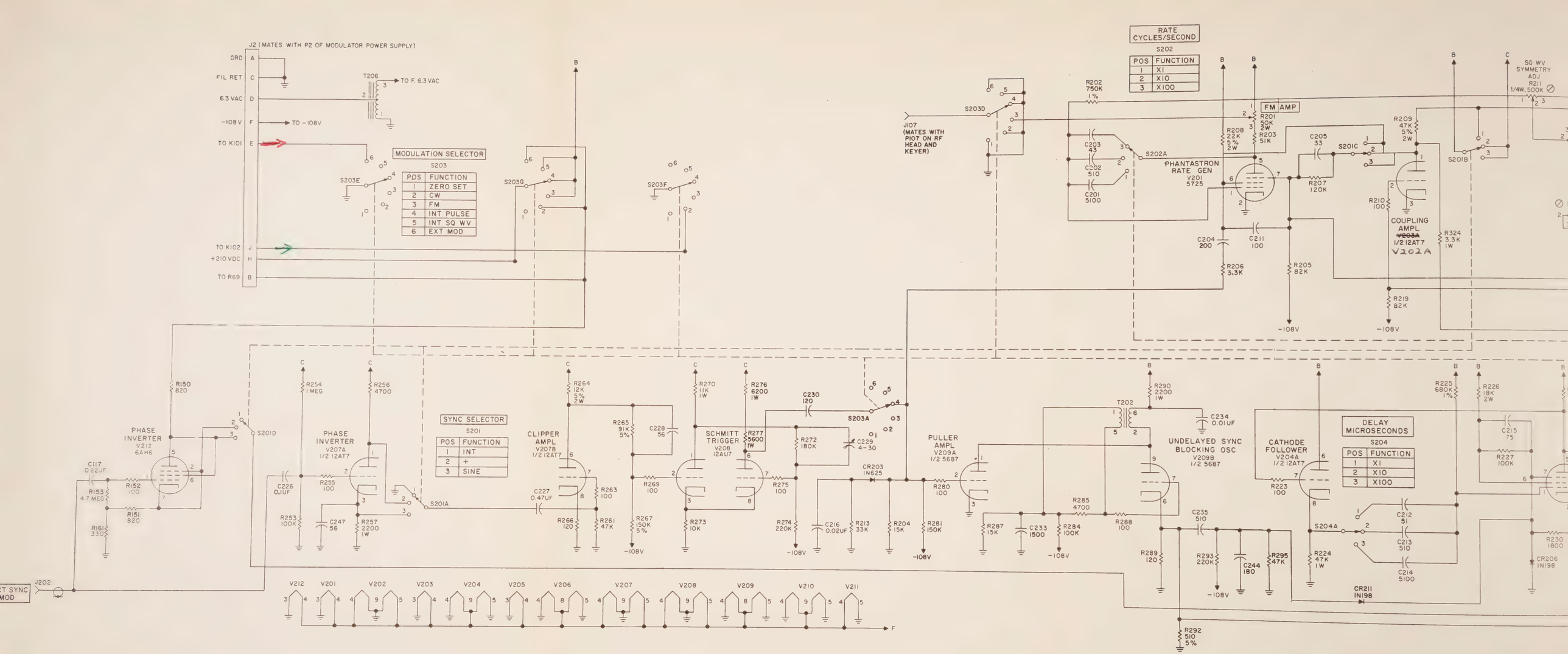
Group 1 units incorporate modulator circuitry that permits external fm capability (see figure 5-1 of the Handbook of Operating and Maintenance Instructions). Group 2 units do not incorporate this external fm capability (see figure A-1). In addition, Group 2 units do not contain Max Delay Adj control R276.

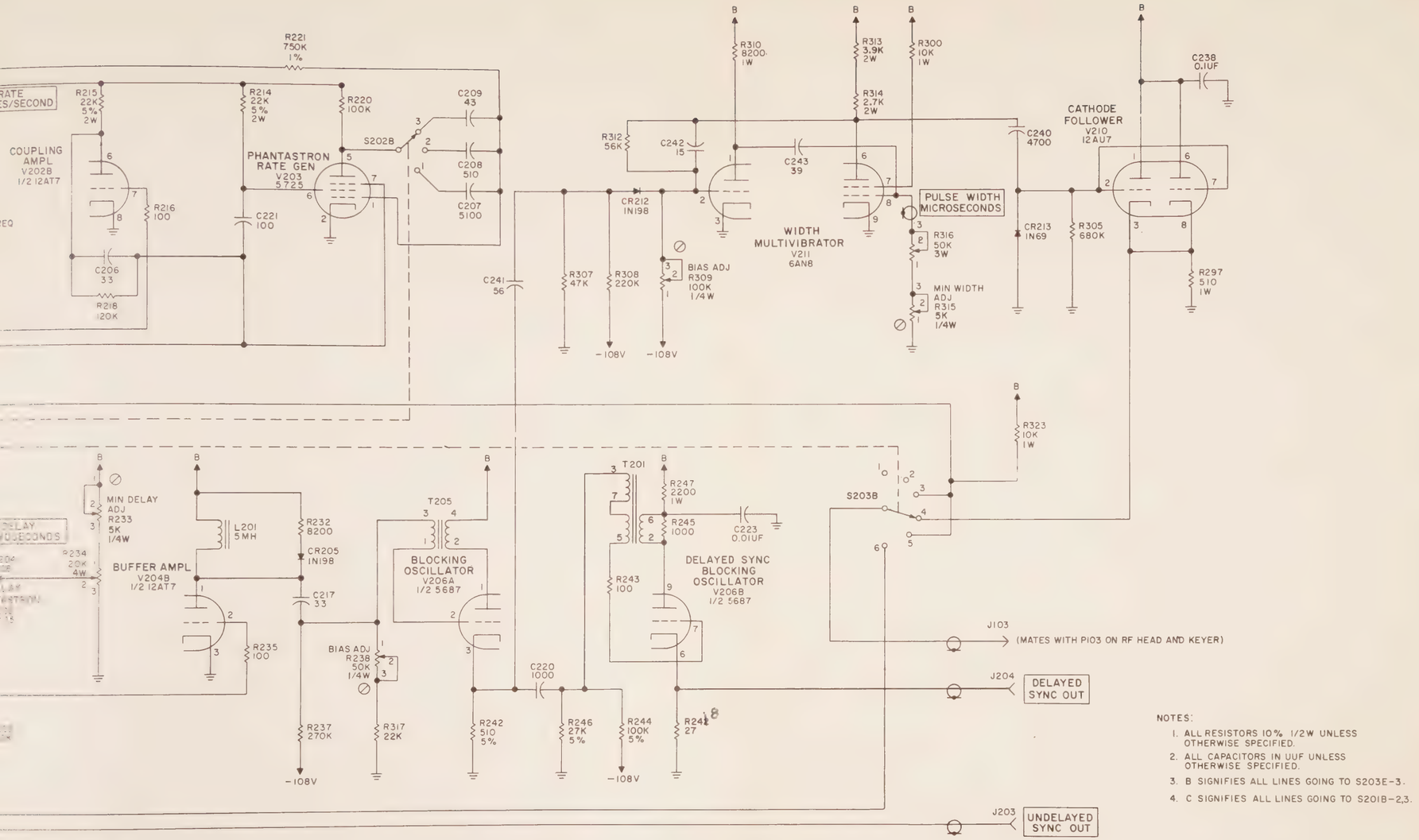
All handbook references to EXT SYNC connector J202 and EXT MOD connector J205 (for Group 2 units) should be changed to EXT SYNC & MOD connector J202.

The operating and maintenance procedures for both Group 1 and Group 2 units are identical, except for the differences noted above.

---

* Group 1 units.
** Group 2 units.


J2 (MATES WITH P2 OF MODULATOR POWER SUPPLY)
GRD A
FIL RET C
6.3 VAC D
-108 V F
TO K101 E
TO K102 J
+210 VDC H
TO R69 B
T206
TO F. 6.3 VAC
TO -108V
MODULATION SELECTOR
S203
POS | FUNCTION
1 | ZERO SET
2 | CW
3 | FM
4 | INT PULSE
5 | INT SQ WV
6 | EXT MOD
S203E
S203G
S203F
RATE CYCLES/SECOND
S202
POS | FUNCTION
1 | X1
2 | X10
3 | X100
J107 (MATES WITH PIOT ON RF HEAD AND KEYER)
S203D
R202 750K 1%
S202A
C203 43
C202 510
C201 5100
PHANTASTRON RATE GEN V201 5725
FM AMP
R201 50K 2W
R208 22K 5% 2W
R203 51K
C205 33
S201C
S201B
R209 47K 5% 2W
R207 120K
R210 100
50 WV SYMMETRY ADJ R211 1/4W, 500K
COUPLING AMPL ~~V203A~~ 1/2 12AT7 V202A
R324 3.3K 1W
C204 200
C211 100
R206 3.3K
R205 82K
R219 82K
-108V
R150 820
PHASE INVERTER V212 6AH6
S201D
C117 0.22UF
R153 4.7 MEG
R152 100
R151 820
R161 330
R254 1 MEG
R256 4700
PHASE INVERTER V207A 1/2 12AT7
C226 0.1UF
R255 100
R253 100K
C247 56
R257 2200 1W
S201A
SYNC SELECTOR
S201
POS | FUNCTION
1 | INT
2 | +
3 | SINE
R264 12K 5% 2W
CLIPPER AMPL V207B 1/2 12AT7
C227 0.47UF
R263 100
R266 120
R261 47K
R265 91K 5%
C228 56
R269 100
R267 150K 5%
SCHMITT TRIGGER V208 12AU7
R270 11K 1W
R276 6200 1W
R277 5600 1W
R273 10K
C230 120
S203A
R272 180K
C229 4-30
CR203 1N625
R274 220K
C216 0.02UF
R213 33K
R204 15K
R275 100
R280 100
R281 150K
PULLER AMPL V209A 1/2 5687
R287 15K
C233 1500
R284 100K
R285 4700
R288 100
T202
R290 2200 1W
C234 0.01UF
UNDELAYED SYNC BLOCKING OSC V209B 1/2 5687
R289 120
R293 220K
C244 180
R295 47K
CATHODE FOLLOWER V204A 1/2 12AT7
R223 100
R224 47K 1W
DELAY MICROSECONDS
S204
POS | FUNCTION
1 | X1
2 | X10
3 | X100
S204A
C212 51
C213 510
C214 5100
C235 510
CR211 1N198
R292 510 5%
R225 680K 1%
R226 18K 2W
C215 75
R227 100K
R230 1800
CR206 1N198
J202
T SYNC MOD
V212 V201 V202 V203 V204 V205 V206 V207 V208 V209 V210 V211
F



NOTES:

1. ALL RESISTORS 10% 1/2W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS IN UUF UNLESS OTHERWISE SPECIFIED.
3. B SIGNIFIES ALL LINES GOING TO S203E-3.
4. C SIGNIFIES ALL LINES GOING TO S201B-2,3.

Figure A-1. Modulator Assembly, Schematic Diagram (Group 2 Units)

POLARAD

POLARAD ELECTRONIC INSTRUMENTS

A DIVISION OF POLARAD ELECTRONICS CORPORATION

34-02 QUEENS BOULEVARD · LONG ISLAND CITY 1, N.Y. · AREA CODE 212 · EXETER 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

B. Has trouble been localized? _____ If so, how and where: _____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional Comments: _____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronic Instruments
Division of
Polarad Electronics Corporation
34-02 Queens Boulevard
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

Condensed Catalog / May 1963

Microwave Electronic Instruments

POLARAD

POLARAD

Spectrum Analyzers 10 — 100,000 mc . . . . . 2 — 3
Spectrum Signature Monitors 400 — 84,200 mc 4
Microwave Receivers 400 — 84,200 mc . . . . . 4 — 5
RI/FI Meters 1,000 — 21,000 mc; Antennas . . . . . 4 — 5
Signal Generators & Signal Sources 500 — 50,000 mc 6
Modular Microwave Signal Generator Equipment 7
Pulse, Impulse, and Noise Generators; Infrared; Related Instrumentation 7
Industry Services 8

POLARAD ELECTRONIC INSTRUMENTS A Division of Polarad Electronics Corp. 34-02 Queens Blvd . Long Island City 1 New York
World Leader in Microwave Instrumentation

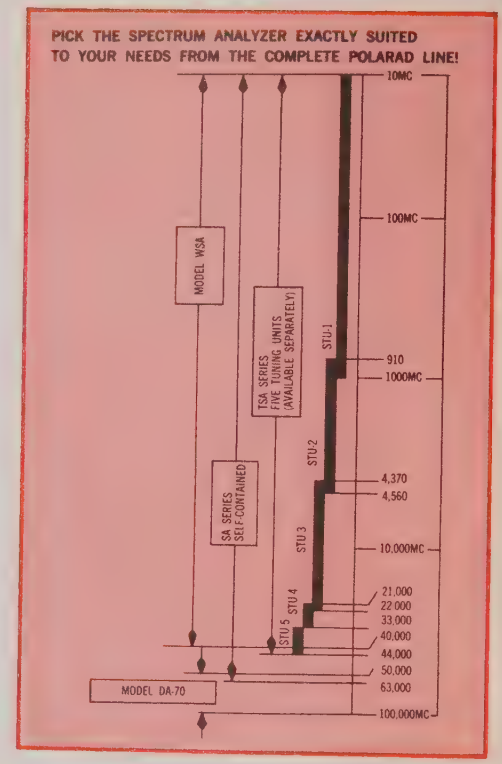
Polarad pioneered the modern microwave spectrum analyzer. Today, this diversified line of instruments provides the designer or test engineer with the most precise and meaningful quantitative and qualitative information about any signal, regardless of complexity or frequency content, up to 100 KMC.

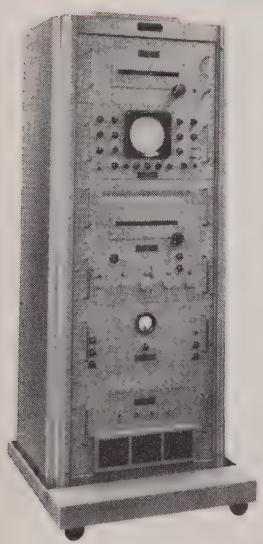
The unequalled dependability, accuracy, and operational convenience provided by these instruments reflect the experience and design ability that have made Polarad the undisputed leader in this demanding form of the microwave instrumentation art.

The features listed below are, in general, common to all Polarad Spectrum Analyzers.

- **Direct-reading UNIDIAL® tuning — no klystron mode-setting!**
- **Frequency Dial Accuracy, ±1%**
- **Sweep-rate adjustable, 1-30 cps**
- **High Sensitivity**
- **Variable resolution for optimum analysis.**
- **Non-contacting klystron-cavity chokes fror noiseless tuning, optimum stability**
- **Five-inch flat-face CRT display**
- **Compatible with Multi-pulse Spectrum Selector SD-1**
- **Low residual FM**

The chart to the right permits rapid selection of the spectrum analyzer best suited to your problem. Note that by taking advantage of the plug-in range selection of the TSA series, you need only purchase the range you need, yet you automatically provide for extending the range later by obtaining additional tuning units as required!





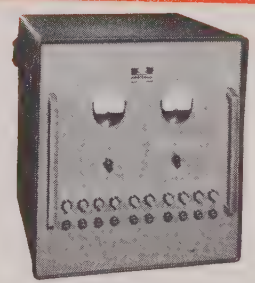
Model WSA

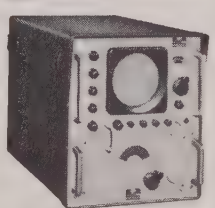
WIDE BAND SPECTRUM ANALYZER 10 - 40,000 MC

Model WSA is a unique universal instrument providing the ultimate in convenience and application flexibility.

Features: rapid range selection by 20 illuminated push-buttons; wide band display—up to 4,000 MC—simplifying field-intensity measurements; end-markers, indicating band limits; frequency marker to 4KMC; Narrow mode: 1-25MC dispersion, 20KC resolution; Wide mode: 50-4,000 MC dispersion, 1.5MC resolution; center marker for wide-to-narrow band switching without loss of signal.

Frequency Range	Nominal Sensitivity
10 mc to 410 mc	—80 dbm
410 mc to 12.4 kmc	—70 dbm
12.4 kmc to 18.5 kmc	—60 dbm
18.5 kmc to 26.0 kmc	—50 dbm
26.0 kmc to 40.0 kmc	—50 dbm

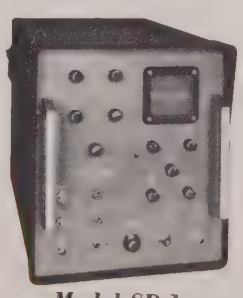




Model DA-70

EHF SPECTRUM ANALYZER

Model DA-70 covers the important range from 50-100 KMC, using a single accurately-calibrated (±1%) tuning unit with exclusive UNIDIAL® convenience. Dispersion is continuously adjustable from 50-1,000MC; Resolution is 1MC. Markers are provided for spectrum calibration to ±5%. High-frequency IF stages insure excellent image rejection, prevent video detection. Sensitivity, —50 dbm, nominal.



Model SD-1

MULTIPULSE SPECTRUM SELECTOR Model SD-1

When used in conjunction with any Polarad spectrum analyzer, this unique instrument permits spectrum analysis of any one selected pulse within a multiple pulse train. Particularly useful in design and analysis of telemetry, IFF, beacons, and radars.

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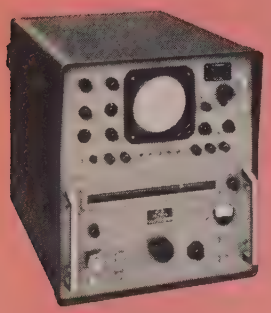
VISUAL MICROWAVE ANALYSIS – 10 to 100,000 MC

POLARAD

SA SERIES

Universal Spectrum Analyzers represent the most advanced designs in the current state of the art. Completely self-contained, with every important marker, control, and calibration facility normally required in spectrum analysis, they cover their entire frequency range without plug-ins or accessories. In particular the new Model SA-84WA provides the widest frequency range ever offered in a universal instrument: 10 MC to 63,680 MC! Also of special interest is the new portable, compact transistorized Model SA-84T . . . 40% lighter, with improved performance.



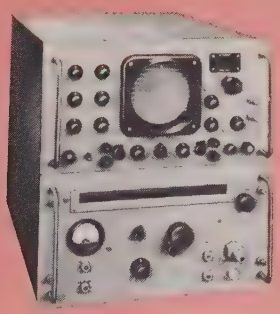
Model SA-84W/WA

Sensitivity to −115 dbm

Wide-Dispersion Universal Design. **Features:** excellent sensitivity; wide-range variable dispersion; wide-range variable resolution; crystal-controlled markers over entire frequency range; log-linear display; accurate IF attenuator.

Model	Frequency	Dispersion	Resolution
SA-84WA	10-63,680MC	25KC-80MC (Available to 100MC)	1KC-80KC
SA-84W	10-40,880MC	25KC-80MC*	1KC-80KC

*25KC-10MC below 240MC.



Model SA-84

Standard Universal design, 10-40,880 MC. **Features:** excellent sensitivity (—40 to —90 dbm, depending on frequency); Variable internal marker, graduations every 200 KC; 25 KC resolution; dispersion adjustable 500 KC — 25 MC (500 KC — 5 MC up to 55 MC). The most economical universal instrument in its class!

Model SA-84T

Portable Transistorized Universal design, 10-40,880 MC. **Features:** excellent sensitivity (—55 to —105 dbm, depending on frequency); ±13 MC internal marker tuning range; 20 KC resolution; dispersion adjustable 500 KC — 25 MC. Operates from 12 volt battery or line power. Truly portable!

TSA SERIES

Spectrum Analyzers can all cover 10-44,000 MC, the actual range being determined by the number of interchangeable plug-in tuning heads purchased. Thus, the engineer may select only the ranges of interest, yet provide for full coverage at some later date, reducing his initial investment.

The basic TSA design is available in three forms: with a conventional variable dispersion, with a wider range of dispersion, and with a built-in synchroscope mode.

TSA/TSA-S	TSA-W	Equipment	Frequency Range	Sensitivity: (minimum discernible signal)
STU-1B	STU-1BW	R-F Tuning Unit	10 to 1,000 mc	10 to 400 mcs —90 to —105dbm 350 to 1,000 mcs —88 to — 95dbm
STU-2B	STU-2BW	R-F Tuning Unit	910 to 4,560 mc	910 to 2,200 mcs —100to —115dbm 1,980 to 4,560 mcs —100to —110dbm
STU-3B	STU-3BW	R-F Tuning Unit	4,370 to 22,000 mc	4,370 to 11,000 mcs —77 to —90 dbm 8,900 to 22,000 mcs —65 to —85 dbm
STU-4B	STU-4BW	R-F Tuning Unit	21,000 to 33,000 mc	21,000 to 33,000 mcs —57 to —75 dbm
STU-5B	STU-5BW	R-F Tuning Unit	33,000 to 44,000 mc	33,000 to 44,000 mcs —50 to —65 dbm

OPTIONS

1. 100 mc Dispersion
2. Phase Lock Capability
3. AM Marker Modulation Input
4. XY Recorder Output & Slow Scan Rate
5. 50 DB on Screen Log Display
6. 63 DB Calibrated IF Attenuator
7. Choice of CRT Phosphor

UNIT

1. TSA-W, SA-84W, SA-84WA
2. All Units
3. All Units
4. TSA, TSA-W, SA-84W, SA-84WA
5. TSA, TSA-W, SA-84W, SA-84WA
6. SA-84T
7. All Units

Model TSA

Provides power vs. frequency display. **Features:** adjustable dispersion, 100 KC — 25 MC; variable resolution, 1-80 KC; ±14 MC marker tuning range; excellent sensitivity (—50 to —115 dbm, depending on frequency); log-amplitude display for wide dynamic range.

Model TSA-W

Provides widest range of dispersions. Shown above are two displays representing extremes of adjustable dispersion range (25 KC — 80 MC). Resolution variable, 1 — 80 KC. ±40 MC marker tuning range. Excellent sensitivity (—50 to —115 dbm, depending on frequency). This instrument will display the spectrum of a 0.1 μsec. pulse!

Model TSA-S

Combines high-performance Synchroscope display (shown above left) with conventional power-vs.-frequency display. Synchroscope sweep rates adjustable from 2μsec/trace to 0.1 sec/trace. Dispersion adjustable, 400 KC —25 MC. Resolution 5/50/500 KC and 5 MC. Marker tuning range, ±14 MC. An excellent dual-purpose research instrument!

POLARAD MICROWAVE RECEIVERS (400-84,200 MC)

Polarad developed many of the fundamental circuit concepts upon which most of the calibrated microwave receivers and field-intensity meters in current use are based. The four instrumentation systems described on these 2 pages represent the highest achievements in the current state of the art.

Among the outstanding features of these instruments are the following:

- Direct-reading ±1% frequency calibration, with digital display and/or UNIDIAL® tuning.
- Complete flexibility of signal reception: AM, FM, CW, Pulse.
- Direct and absolute signal-level calibration — with internal calibrating generators in the RI/FI meters.
- Complete range of compatible calibrated and uncalibrated antennas with exceptional directivity and low VSWR.

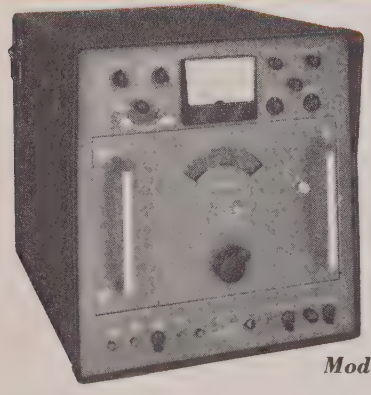
TRANSISTORIZED MICROWAVE RECEIVER

0.95-21 KMC.
Portable, compact, rugged.
Four instruments in one: AM, FM, CW, MCW, Receiver; Pulse Receiver; Field-Intensity Receiver, and sensitive Power Meter.

Model TR

- AFC, AGC circuits.
- Digital frequency dial.
- 60 db linearity range!
- Impulse Bandwidth: 1 MC, 5 MC, or wideband.
- Output calibrated directly in db.
- Preselection on all tuning units.
- Video Bandwidth, 4 MC.
- Sensitivity: —77 dbm minimum.
- Choice of 12V battery or line power.
- Audio, video, recorder outputs.

Six Interchangeable Plug-In Tuning Units		
Tuning Unit No.	Frequency Range	Minimum Sensitivity
T-RL	950 — 2,040 mc	— 90 dbm
T-RS	1,900 — 4,340 mc	— 90 dbm
T-RM	4,200 — 7,740 mc	— 87 dbm
T-RX	7,300 — 11,260 mc	— 87 dbm
T-RKS	9,850 — 15,350 mc	— 80 dbm
T-RKU	14,800 — 21,000 mc	— 77 dbm



ULTRA-WIDE-BAND MICROWAVE RECEIVER

0.4-84.2 KMC! Choose only the tuning ranges you require, yet provide for full coverage later — thus effecting significant saving in initial investment! Four instruments in one: AM, FM, CW, MCW, Receiver; Pulse Receiver; Field Intensity Receiver, sensitive Power Meter.

Model R

- AFC, AGC circuits.
- Direct-reading UNIDIAL®.
- 60 db linearity range!
- Image and Spurious Response rejection better than 60 db up to 11.26 KMC.
- Video Bandwidth, 2 MC.
- Sensitivity: —85 to —55 dbm (minimum), depending on frequency range.
- Output calibrated directly in db.
- Audio, video, recorder outputs.

Ten Interchangeable Plug-In Tuning Units:		
Tuning Unit	Frequency Range	Minimum Sensitivity
Model RR-T	395 to 1,050 mc	—85 dbm
Model RL-T	950 to 2,040 mc	—80 dbm
Model RS-T	1,900 to 4,340 mc	—80 dbm
Model RM-T	4,200 to 7,740 mc	—80 dbm
Model RX-T	7,300 to 11,260 mc	—80 dbm
Model RKS-T	9,500 to 15,600 mc	—65 dbm
Model RKU-T	14,700 to 22,000 mc	—65 dbm
Model RQ-T	20,260 to 31,260 mc	—65 dbm
	30,260 to 46,700 mc	—55 dbm
Model RE-T	45,300 to 84,200 mc	—55 dbm
Model RW-T*	2,000 to 75,000 mc	—70 to —85 dbm

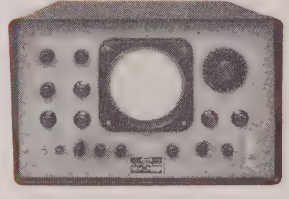
*Antenna Pattern Tuning Unit. External mixer with flexible cable. Locate up to 75 ft. from receiver, at or near antenna.

MICROWAVE TEST ANTENNAS

Calibrated (MIL-I-26600 approved) and uncalibrated types. Highly directional, linearly polarized, high front/back ratio, max VSWR of 3:1. Lightweight, portable, rugged construction.

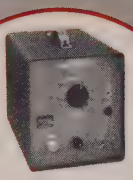
CALIBRATED TEST ANTENNAS		TEST ANTENNAS	
Model	Frequency Range	Model	Frequency Range
CA-B	1,000 to 10,000 MC	UH1	400 to 1,000 MC
CA-L	1,000 to 2,340 MC	L	1,000 to 2,300 MC
CA-S	2,140 to 4,340 MC	S	2,150 to 4,600 MC
CA-M	4,190 to 7,740 MC	M	4,450 to 8,000 MC
CA-X	7,360 to 10,000 MC	X	7,850 to 12,400 MC
CA-KS	9,800 to 15,350 MC	Ku	12,400 to 18,000 MC
CA-KU	14,750 to 21,000 MC	K	18,000 to 26,500 MC
CA-KSO	9,850 to 15,350 MC	Ka	26,500 to 40,000 MC
CA-KUO	14,750 to 21,000 MC		
CA-T	Tripod		

SPECTRUM SIGNATURE MONITOR MODEL DM-1



Converts your Receiver or RI/FI Meter for Visual Display of Signal Power vs Frequency

Model DM-1 utilizes 140-megacycle IF output of receiver or meter to provide linear or logarithmic display of signal amplitude versus frequency-components, on 5-inch CRT. Variable resolution 1-80 KC, adjustable dispersion 150 KC-25MC, attenuation from 0-40 db, and calibrated marker pips variable ±14 MC, permit meaningful signal analysis over the receiver's frequency range. An efficient, economical way to add a Spectrum Analyzer to your lab or field instrumentation!



See later page for data on Model IC-120A/B Impulse Calibrator — same characteristics as calibrator in Model CFI.

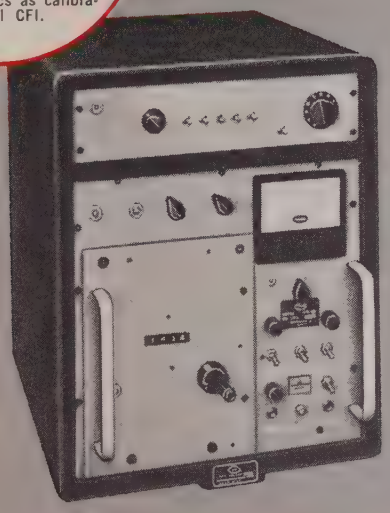
TRANSISTORIZED CALIBRATED FIELD-INTENSITY (RI/FI) METER — 1,000 to 15,000 MC.

USAF approved RI/FI measurements to 10KMC per Category A of MIL-I-26600 and MIL-I-6181!

Transistorized, portable, compact, ruggedized.

Combines an impulse calibrator, field-intensity meter, and calibrated antenna system. Provides accurate measurements of frequency and absolute power level of conducted or radiated microwave energy. Choice of 12V battery or line-power operation.

Features: UNIDIAL® tuning; Direct-reading **digital** frequency dial; ±1% frequency accuracy; Choice of 3 impulse bandwidths — 1, 5, wideband MC; output level direct-reading in db; Image and spurious response rejection better than 60 db; Max. RF input, 3 volts. Audio, video, recorder outputs. AM, FM, CW, and Pulse reception.



Model CFI

Five Interchangeable Plug-In Tuning Units		
Tuning Unit No.	Frequency Range	Minimum Sensitivity
CFI-L	1,000 — 2,040 mc	—90 dbm
CFI-S	1,900 — 4,340 mc	—90 dbm
CFI-M	4,200 — 7,740 mc	—86 dbm
CFI-X	7,300 — 10,000 mc	—85 dbm
CFI-KS	9,850 — 15,000 mc	—80 dbm

All Polarad RI/FI systems are furnished with the appropriate calibrated antennas, per MIL-I-26600

CALIBRATED MICROWAVE FIELD-INTENSITY (RI/FI) METER — 1,000 to 21,000 MC!

Full Category A Air-Force Approval Per MIL-I-26600 and MIL-I-6181 to 10 KMC!

Widest range ever offered in a microwave RI/FI meter!
Combines internal signal generator, field-intensity meter, and calibrated antenna system. Provides accurate absolute power level and frequency measurements. The signal level indication is in microvolts, db above 1 microvolt, and db above 1 microvolt per megacycle.

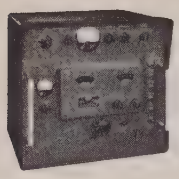
Model FIM-2

- **Only microwave Field Intensity Receiver with self-contained signal generator which calibrates entire system under test at any level.**
- **First single microwave test system to determine radiated r-f interference and susceptibility.**
- **Front-panel meter indicates average, peak, slide-back peak or quasi-peak value of r-f signals. Outputs for video, audio and recorder.**
- **Six interchangeable tuning heads cover 1,000 to 21,000 mc.**
- **Direct-indicating peak VTVM for ease of frequency location of impulse noise.**
- **Single UNIDIAL® tuning control tunes both the receiver and signal generator.**
- **Calibrated antenna system includes an omni-directional broadband antenna and separate directional antennas to match each tuning unit.**
- **Frequency Dial Accuracy: ±1%**
- **Maximum RF Input: 3 volts**
- **Impulse Bandwidth: 5 mc**
- **Image and Spurious Response Rejection: Better than 60 db**
- **Attenuation: 0 to 80 db in steps of 1 db**

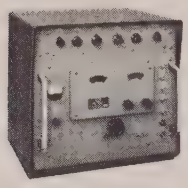
Six Interchangeable Plug-In Tuning Units†:		
Tuning Unit No.	Frequency Range	Minimum Sensitivity
FIM-L2	1,000 to 2,240 mc	—81 dbm
FIM-S2	2,140 to 4,340 mc	—81 dbm
FIM-M2	4,200 to 7,740 mc	—81 dbm
FIM-X2	7,360 to 10,000 mc	—81 dbm
FIM-KS	9,850 to 15,350 mc	—73 dbm
FIM-KU	14,800 to 21,000 mc	—70 dbm

†U.S. Patent 2,774,243

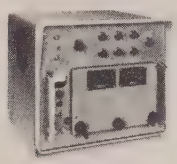
POLARAD MICROWAVE SIGNAL GENERATORS



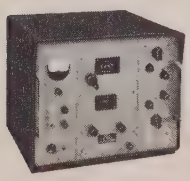
Model PMR



odel MSG-1R/2R/2PA



Model PMX



Model MSG-34

Model KSS

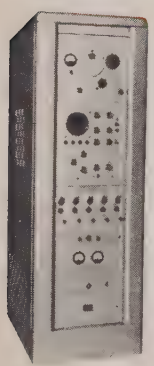
Polarad signal generators and sources incorporate every significant mechanical and electronic advancement known to the art, including a number of Polarad exclusives. These instruments are used by the thousand in every phase of microwave development and measurement. They are widely used in permanent test consoles, because of their exceptional stability and reliability. In particular, experienced engineers appreciate the outstanding features listed here, which generally apply to all units in the line, with some variations.

- **Accurate frequency calibration — ± 1%, except EHF ± 0.1%**
- **DIRECT-reading UNIDIAL® (EHF has direct-reading wavemeter).**
- **Low thermal and power-line drift.**
- **Exceptional permanence of calibration.**
- **Extremely versatile modulation capabilities.**
- **Accurate, directly-calibrated attenuators.**
- **Generators all have accurate absolute power-level calibration.**

500-11,000 MC SERIES

Features include: High-stability, non-contacting klystron-cavity shorts for noiseless tuning, calibration permanence; UNIDIAL®; exceptionally complete modulation capability. The PMR is particularly notable for its precise, wide-range, low distortion FM capability, extremely valuable in microwave telemetry applications.

MODEL	FREQUENCY KMC	CALIBRATED POWER OUTPUT	INTERNAL MODULATION
PMR	0.5 - 1.0	−3 dbm (0.5 MW) to −127 dbm	FM: 100-100,000 cps, 0 to ±300 KC deviation. < 1% harmonic distortion.
MSG-1R	0.95 - 2.40	0 dbm (1 MW) to −127 dbm	All instruments in this group: pulse & FM modulation: 10-10,000 pps. *pulse width: 0.2-10 μsec. pulse delay: 2-2,000 μsec. square-wave modulation: 10-10,000 pps. FM deviation: ±2.5 MC min. *0.3-10 μsec. in MSG-1R and MSG-2PA
MSG-2R	2.0 - 4.60	0 dbm (1 MW) to −127 dbm	
MSG-2PA	2.4 - 4.0	+10 dbm (10 MW) to −127 dbm	
PMX	4.45 - 11.0 (2 plug-ins)	0 dbm (1 MW) to −127 dbm	
MSG-34 (Ultra Broadband)	4.2 - 11.0 digital freq. indicator	0 dbm (1 MW) to −127 dbm	
KSS (Signal Source)	1.05 - 11.0 (4 plug-ins)	Uncalibrated Power Output: 14-400 MW, depending on freq.	sq-wave, 10-10,000 pps (external pulse, sq-wave FM)



Model B

MULTI-PULSE CODE-MODULATED MICROWAVE SIGNAL GENERATOR

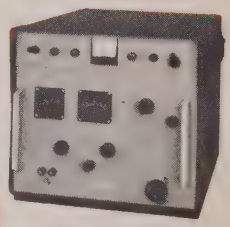
Provides microwave signals (0.95-10.75 KMC) modulated by coded pulse combinations, for testing and simulating IFF, radar, beacons, navigation systems, telemetry, communication links, missile guidance systems. Five independent pulse generators combine to produce complex modulation codes. (See description of MP-1A on opposite page for additional data on modulator.) Built-in precision 'scope.

Four Interchangeable Oscillators	
Tuning Unit	**Frequency Range**
BL-1	950 to 2,400 mc
BS-1	2,150 to 4,600 mc
BC-1	4,450 to 8,000 mc
BX-1	7,850 to 10,750 mc

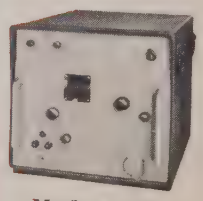
EXTREMELY HIGH FREQUENCY MICROWAVE SIGNAL GENERATORS & SOURCES

Generators are frequency and power calibrated, Sources are frequency calibrated only. CW, 1KC internal AM, or external modulation. High power output. See chart for plug-in tuning units. Also available: SG1218 (Generator) or SS1218 (Source) 12.4-17.5 KMC.

EHF SIGNAL GENERATOR Tuning Unit	Frequency Range	EHF SIGNAL SOURCE Tuning Unit
G1822-1	18,000 to 22,000 mc	S1822-1
G2225-1	22,000 to 25,000 mc	S2225-1
G2427-1	24,700 to 27,500 mc	S2427-1
G2730-1	27,270 to 30,000 mc	S2730-1
G3033-1	29,700 to 33,520 mc	S2933-1
G3336-1	33,520 to 36,250 mc	S3336-1
G3540-1	35,100 to 39,700 mc	S3540-1
	39,600 to 46,000 mc	S4046-1
	45,900 to 50,000 mc	S4650-1



Model EHF Generator



Model EHF Source

POLARAD

MODULAR MICROWAVE SIGNAL-GENERATOR COMPONENTS

3,800 TO 21,000 MC

Model 1809/10 Signal Generator

Latest addition to the Polarad line, this integrated group of seven elements offers the system designer a choice of 86 useful basic combinations for composing a precision signal reference source in the 3,800 to 21,000 megacycle range. These light, compact, self-powered elements can be mounted in your laboratory rack, or stacked in your field location. Any Generator or Source may be used alone, or with the appropriate Doubler; combinations of Generators and/or Sources may share the use of one or both Doublers, and the Modulator may be used as a common driver in all cases. From a single unit to the most elaborate console, all installations offer the same high standards of accuracy, stability, and reliability that characterize the Polarad line of microwave equipment.

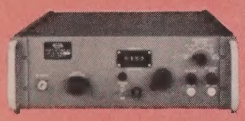
SIGNAL GENERATORS

Model 1107 Model 1108

Featuring digital frequency readout with ±0.5% accuracy. VSWR of 2:1 maximum, internal modulation 800—1200 cps square wave, and 800—1200 cps FM sawtooth with continuously adjustable sweepwidth to ±5 MC from center frequency. Accepts external 1 cps to 1 MC pulse, square wave modulation and 100 cps — 500 KC frequency modulation.

Calibrated power output of 2 MW (+3 dbm) down to —127 dbm, with ±2 db absolute accuracy.

SIGNAL SOURCES



Model 1207 Model 1208

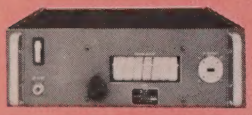
Features identical to signal generators above without calibrated output power.

Minimum power output Model 1207—50 MW. Model 1208—25 MW.

FREQUENCY DOUBLERS

Model 1509
Output: 10,000—15,500 MC
Input: 5,000—7,750 MC

Model 1510
Output: 15,000—21,000 MC
Input: 7,500—10,500 MC



Less than 18 db conversion loss; 250 MW max. input power, 2:1 max. VSWR. Calibrated power output of 1 MW (0 dbm), with frequency-insensitive attenuator, continuously variable from 0 to —100 dbm, calibrated directly in-dbm, accurate to ±2 db.

MODULATOR

Model 1001 Pulse Square Wave and Sawtooth FM

Designed to drive above generators and sources. 10-10,000 pps, positive 20-volt-peak output pulses, 0.2-10 microseconds wide, internal or external synchronization. 150-ohm output impedance permits driving up to 10 feet of interconnecting cable if necessary. Sync pulse output delivers 15-volt positive pulse, with adjustable delay up to 2000 microseconds.

Now! ELECTRO-OPTICAL INSTRUMENTATION!

. . . from TELEWAVE LABORATORIES, INC.

(a subsidiary of Polarad Electronics Corporation)

INFRA-PAK™

MODULAR COMPONENTS for the infrared, visible, and ultraviolet bands.

An integrated system of components for generating, processing, detecting and measuring radiation.

Already available: precision adjustable radiation sources, variable and fixed-frequency filters, variable-speed optical choppers, variable and step-attenuators, lens systems, calibrated detector-snychronous amplifier radiation monitors. More coming soon!

POLARAD MICROWAVE INSTRUMENTS & ACCESSORIES

WIDE-BAND: 1 MC to 10,000 MC, flat within ±0.5 db. Generates 0.02 nanosecond pulses!

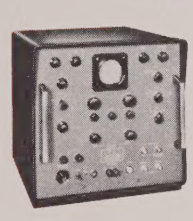
VERSATILE: Calibrates microwave receivers for RI/FI work. Ideal signal source for checking spectrum analyzers. Recommended for noise, bandwidth, and jamming measurements.

CONVENIENT: Choice of mobile battery or power line operation. Light and compact — truly portable. Output directly calibrated in db above 1 μvolt/MC bandwidth. Two power level ranges. Impulse level adjustable. Regulated power supplies.

TRANSISTORIZED MICROWAVE IMPULSE GENERATOR

Model IC-120A/B

PULSE JITTER TESTER



VERSATILE: Measures pulse-width jitter, repetition-rate jitter, and pulse-to-pulse jitter, displays envelope of jitter, permitting complete analysis and identification of disturbance frequency. Separate video and disturbance-freq. outputs.

WIDE-RANGE: Ranges from 5 nanoseconds to 100 μseconds full scale on absolute (prf) jitter, and 5-100 nanoseconds full scale on relative jitter. Resolves down to 0.5 nanoseconds accurately! Prf acceptable from 50-6,000 pps. Accepts 0.2-10 μsec width pulses, 5 to 50 volts amplitude, positive or negative.

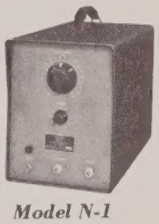
CODED MULTI-PULSE GENERATOR

Provides 5 identical, independently-adjustable (width and delay) plug-in pulse generators, each of which may be independently pulse-time-modulated by external signal. External or internal synch. Interval markers, every microsecond. Auxiliary output trigger at "zero time", output square wave coincident with pulse group. Extremely flexible pulse — group generator/modulator. High power output — up to 20 volts into 100Ω!

Model MP-1A

PRECISION NOISE GENERATOR

Stable 1 KC to 500 MC noise source for direct measurement of noise figure of vacuum-tube and transistor amplifiers, receivers. Direct-reading, accurately-calibrated 1-20 db output control (with 0-1 db interpolation control) ±0.25 db accuracy. Accommodates wide range of terminating impedances. Employs long-life, inexpensive noise tubes. Simple, accurate, trouble-free!



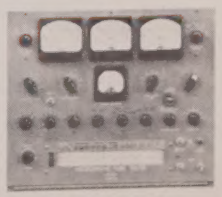
Model N-1

ALL-CERAMIC REFLEX KLYSTRONS

An integrated family of rugged reflex klystrons for CW, FM, or pulse operation in an external cavity. Ceramic construction withstands shock, vibration and thermals, 250°C seal temperature without forced cooling. Request complete application data, curves, design assistance.

MICROWAVE TUBE TESTER

Checks klystrons, pencil triodes, rocket and lighthouse tubes for static operating levels, shorts, filament continuity, as simply as a conventional tube tester. Provides and monitors wide range of cathode, anode, reflector, and grid voltages and currents; functions as universal klystron power supply. Wide ranges, special mounts, integral blower, allow for future tubes as well as present types.



Model K-200

POLARAD *Services to the industry*

"Project Mohammed"

Latest of the many innovations pioneered by Polarad is the MOBILE MICROWAVE CALIBRATION PROGRAM, bringing a fully-equipped microwave calibration laboratory to your door, by appointment, to perform NBS-traceable calibrations on your microwave instruments, in a matter of hours! Certificates (suitable for comformance to MIL-Q-9858) will then be issued by the Polarad Calibration Engineer, on the spot. Your Polarad representative has complete details on how we are "bringing the Mountain to Mohammed", including price lists, test standards, and an approximate itinerary for the Mobile Calibration Laboratory. Just ask him to tell you about "Project Mohammed"!

Polarad Field Engineers are competent, professional, and always fully informed — call on your local Polarad representative with complete confidence.

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Los Angeles, Calif., Phone 938-2074
La Jolla, Calif., Phone 454-2191
Palo Alto, Calif., Phone 968-8304

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Vidal Electronics Co.
Dallas, Texas, Phone 247-4252

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Harvey Teplitz & Co.
Dayton, Ohio, Phone 277-9178
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Huntsville, Ala., Phone 536-9121

NEW ENGLAND
George Gregory Associates
Natick, Mass., Phone 235-9070
Cheshire, Conn., Phone 272-5040

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Engineering Services Co.
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St. Louis, Mo., Phone 726-2233
Wichita, Kansas, Phone 683-3751
Cedar Rapids, Iowa, Phone 366-1591

METROPOLITAN NEW YORK CITY
Eastern Instrumentation, Inc.
Great Neck, Long Island, N. Y., Phone 466-9505

VIRGINIA • WASHINGTON, D. C.
WEST VIRGINIA
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